STATE OF NEVADA
Department of Education
SCHOOL BUS STANDARDS

2000

Keith W. Rheault
Superintendent of Public Instruction

Gloria Dopf
Deputy Superintendent, Instructional, Research & Evaluative Services

James R. Wells
Deputy Superintendent, Administrative & Fiscal Services

Diana Hollander
Program Officer, Pupil Transportation

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INTRODUCTION

The purpose of the **Nevada School Bus Standards** is to provide district transportation personnel with unified Nevada school bus standards. These standards were developed from the **13th National Conference on School Transportation,** which was held in May of 2000. These standards were approved during the **September 8, 2000** State Board Meeting.

All district transportation personnel are required to adhere to these standards when purchasing school buses. These regulations are also utilized by the Highway Patrol when inspecting new school buses.

It is the intent of these specifications to accommodate **new technologies and equipment** that will better facilitate the transportation of students. When the new technology, piece of equipment, or component is desired to be applied to the school bus, and it meets the following criteria, it may be acceptable.

The new technology, equipment or component shall not compromise the effectiveness or integrity of any major safety system, unless it completely replaces the system. (Examples of safety systems include, but are not limited to, compartmentalization, the eight light warning system, emergency exit opportunity, and the uncluttered yellow color scheme. It shall not diminish the safe environment of the interior of the bus.

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SCHOOL BUS DEFINITIONS

School Bus Definitions

Type A

A Type "A" school bus is a van conversion or bus constructed utilizing a cutaway front-section vehicle with a left side driver's door, the entrance door is behind the front wheels. This definition includes two classifications: Type A1, with Gross Vehicle Weight Rating (GVWR) less than or equal to 10,000 pounds; and Type A2, with a GVWR greater than 10,000 pounds.

Type B

The Type "B" school bus is constructed utilizing a stripped chassis. The entrance door is behind the front wheels. This definition includes two classifications: Type B1 with a GVWR less than or equal to 10,000 pounds, and Type B2, with a GVWR greater than 10,000 pounds.

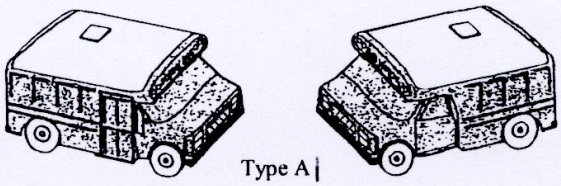
Type C

The type "C" school bus is a constructed utilizing a chassis with a hood and front fender assembly. The entrance door is behind the front wheels.

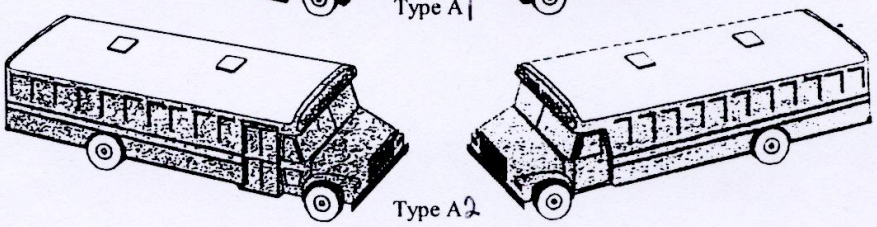
Type D

The Type "D" school bus is constructed utilizing a stripped chassis. The entrance door is ahead of the front wheels.

A Type "A" school bus is a van conversion or bus constructed utilizing a cutaway front-section vehicle with a left side driver's door. The entrance door is behind the front wheels. This definition includes two classifications: Type A1, with a Gross Vehicle Weight Rating (GVWR) less than or equal to 10,000 pounds; and Type A2, with a GVWR greater than 10,000 pounds.

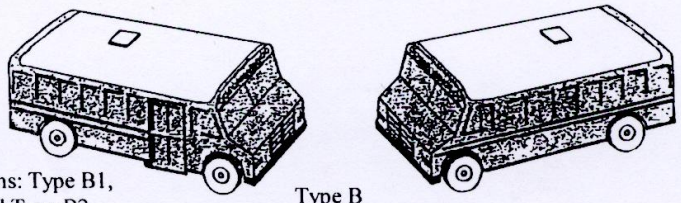


Type A1



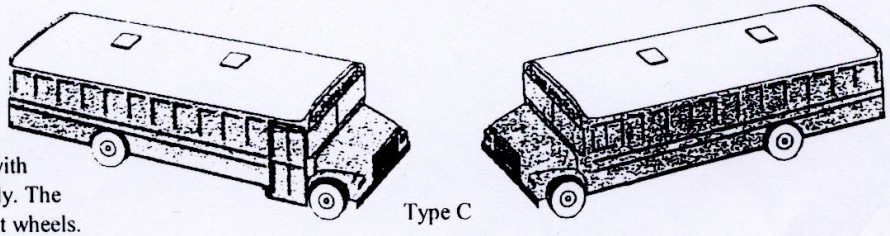
Type A2

A Type "B" school bus is constructed utilizing a stripped chassis. The entrance door is behind the front wheels. This definition includes two classifications: Type B1, with a GVWR less than or equal to 10,000 pounds; and Type B2, with a GVWR greater than 10,000 pounds.



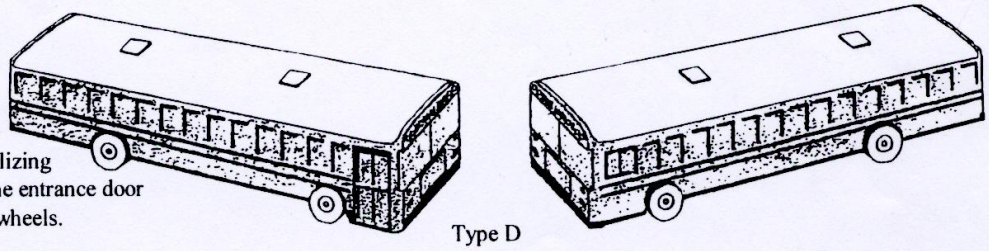
Type B

A Type "C" school bus is constructed utilizing a chassis with a hood and front fender assembly. The entrance door is behind the front wheels.



Type C

A Type "D" school bus is constructed utilizing a stripped chassis. The entrance door is ahead of the front wheels.



Type D

BUS CHASSIS STANDARDS

AIR CLEANER

1. A dry element type air cleaner shall be provided.

2. All diesel engine air filters shall include a restriction indicator of the latching type that retains the maximum restriction developed during operation of the engine. The indicator should include a reset control so the indication can be returned to zero when desired.

AXLES

1. The front and rear axle and suspension systems shall have a gross axle weight rating (GAWR) at ground commensurate with the respective front and rear weight loads that will be imposed by the bus.

BRAKES GENERAL

1. The chassis brake system shall conform to the provisions of Federal Motor Vehicle Safety Standards 105, 106 and 121 as applicable.

2. The anti-lock brake system (ABS) provided in accordance with FMVSS 105 or 121 shall provide wheel speed sensors for each front wheel and for each wheel of at least one rear drive axle, and shall provide anti-lock braking performance for each wheel equipped with sensors. (Four Channel System)

3. All brake systems shall be designed to permit visual inspection of brake lining wear without removal of any chassis components.

4. The brake lines, booster-assist lines, and control cables shall be protected from excessive heat, vibration and corrosion and installed in a manner which prevents chafing.

5. The parking brake system for either air or hydraulic service brake systems may be of a power-assisted design. The power parking brake actuator should be push-pull device located on the instrument panel within seated reach of a 5th percentile female driver. An optional actuating mode may be a "park" position integrated with the transmission shift control that sets the parking brake when placed in the park position.

6. The power operated parking brake system may be interlocked to the engine key switch. When the parking brake has been set followed by turning the key switch to the off position, the parking brake cannot be released until the key switch is turned back to the on position.

BRAKES, HYDRAULIC

1. Buses using a hydraulic-assist brake shall be equipped with warning signals, readily audible or visible to the driver that will provide continuous warning in the event of a loss of fluid flow from the primary source and in the event of discontinuity in that portion of the vehicle electrical system that supplies power to the backup system.

BRAKES, AIR

1. The air pressure supply system shall include an air dryer installed according to manufacturer's recommendations.

2. The air pressure storage tank system may incorporate an automatic drain valve.

3. The Chassis manufacturer should provide an accessory outlet for air operated systems installed by the body manufacturer. This outlet shall include a pressure protection valve.

4. For air brake systems, an air pressure gage shall be proved in the instrument panel capable of complying with CDL pre-trip inspection requirements.

5. All air brake systems may include a system for anti-compounding of the service and parking brakes.

6. Air brake systems may include a system for anti-compounding of the service and parking brakes.

7. Air brakes shall have both a visible and audible warning whenever the air pressure falls below the level where warnings are required under FMVSS 121, item #14.

BUMPER, FRONT

1. All school buses shall be equipped with a front bumper. The front bumper shall be furnished by the chassis manufacturer as part of the chassis on all types of chassis unless there is a specific arrangement between the chassis manufacturer and the body manufacturer that the body manufacturer will furnish the front bumper.

2. The front bumper (except for TYPE A buses if OEM supplied) shall be of pressed steel channel or equivalent material at least 3/16" thick and not less that 8" wide (high) and shall extend beyond the forward-most part of the body, grille, hood, and fenders and shall extend to outer edges of the fenders at the bumper's top line.

3. Front bumper, except breakaway bumper ends, shall be of sufficient strength to permit pushing a vehicle of equal gross vehicle weight without permanent distortion to the bumper, chassis, or body.

4. Tow eyes or hooks shall be furnished and attached so as not to project beyond the front bumper. Tow eyes or hooks attached to the frame chassis shall be furnished by the chassis manufacturer. This installation shall be in accordance with the chassis manufacturer's standards.

5. The bumper shall be designed or reinforces so that it will not deform when the bus is lifted by a chain that is passed under the bumper (or through the bumper if holes are provided for this purpose) and attached to both tow eyes. For purpose of meeting this standard, the bus shall be empty and positioned on a level, hard surface and both tow eyes shall share the road equally.

CERTIFICATION

1. Chassis manufacturer will, upon request, certify to the state agency having pupil transportation jurisdiction that their product meets minimum standards on items not covered by certification issued under requirements of the National Traffic and Motor Vehicle Safety Act.

CLUTCH

1. Clutch torque capacity shall be equal to or greater than the engine torque output.

2. A starter interlock shall be installed to prevent actuation of the starter if the clutch pedal is not depressed.

COLOR

1. Chassis, including front bumper, shall be black. Body cowl, hood, and fenders shall be in national school bus yellow. The flat top surface of the hood may be non-reflective black or national school bus yellow. (See Appendix B).

2. Demountable rims and wheels, if used, may be, silver, gray, white, yellow or black as received from the wheel manufacturer.

DRIVE SHAFT

1. Drive shaft shall be protected by a metal guard or guards around the circumference of the drive shaft to reduce the possibility of its whipping through the floor or dropping to the ground if broken.

ELECTRICAL SYSTEM

1. Battery

    a. Storage battery shall have a minimum cold cranking capacity rating equal to the cranking current required for 30 seconds at 0 degrees Fahrenheit (-17.80C) and a minimum reserve capacity may be required depending upon optional equipment and local environmental conditions.

    b. Since all batteries are to be secured in a sliding tray in the body, chassis manufacturers shall temporarily mount the battery on the chassis frame, except that van conversion or cutaway front-section chassis may be manufacturer's standard configuration. In these cases, the final location of the battery and the appropriate cable lengths shall be mutually agreed upon by the chassis and body manufacturer. In all cases, however, the battery cable provided with the chassis shall have sufficient length to allow some slack.

2. Alternator

    a. All Type A-2 buses and Type B buses up to 15,000 lbs GVWR shall have a minimum 100 ampere alternator.

    b. Type A-2 and Type B buses over 15,000 lbs GVWR and all types C and D buses shall be equipped with a heavy-duty truck or bus-type alternator meeting SAE J 180, having a minimum output rating of 100 amperes or higher, and should produce a minimum current output of 50% of the rating at engine idle speed.

    c. Buses equipped with accessories such as electrically powered wheelchair lift, air conditioning, etc. may be equipped with a system voltage sensing automatic engine idle speed advance device to improve alternator performance.

    d. Direct-drive alternator is permissible in lieu of belt drive. Belt drive shall be capable of handling the rated capacity of the alternator with no detrimental effect on other driven components. Refer to School Bus Technical Reference, 1996 edition for estimating required alternator capacity.

3. Wiring

    a. All wiring shall conform to current applicable recommended practices of the Society of Automotive Engineers (SAE).

        1. All wiring shall use color and at least one other method of identification. The other method shall either be a number code or name code, and each chassis shall be delivered with a wiring diagram that illustrates the wiring of the chassis.

    b. Chassis manufacturer shall install a readily accessible terminal strip or plug on the body side of the cowl, or in an accessible location in the engine compartment of vehicles

designed without a cowl, that shall contain the following terminals for the body connections:

1) Main 100 amp body circuit

2) Tail lamps

3) Right turn signal

4) Left turn signal

5) Stop lamps

6) Back up lamps

7) Instrument panel lights (rheostat controlled by headlamp switch)

4. Circuits

   a. An appropriate identifying diagram (color plus a name or number code) for all chassis electrical circuits shall be provided to the body manufacturer for distribution to the end user.

   b. Headlight system must be wired separately from the body-controlled solenoid.

5. Daytime Running Lights

   a. Exterior low-beam headlights and taillights may be provided with a switch to automatically operate said lamps when the vehicle's ignition is engaged. This switch, if furnished, shall not engage while the starter is engaged. If this switch is designed to provide reduced illumination under normal operating conditions, a means whereby the headlights and taillights can be engaged at full power shall be provided.

   b. Chassis manufacturer shall provide a means for body manufacturer to include the taillights in the DRL circuit.

ENGINE FIRE EXTINGUISHER

1. Manufacturer may provide an automatic fire extinguisher system in the engine compartment.

EXHAUST SYSTEM

1. Exhaust pipe, muffler and tailpipe shall be outside the bus body compartment and attached to the chassis so as not to damage any other chassis component.

2. Tailpipe shall be constructed of a corrosion-resistant tubing material at least equal in strength and durability to 16-gauge steel tubing.

3. Chassis manufacturers shall furnish an exhaust system with tailpipe of sufficient length to exit the rear of the bus or at the left side of the bus body no more than 18" forward of the front edge of the rear wheel house opening. If designed to exit at the rear of the bus, the tailpipe shall extend at least five inches beyond the end of the chassis frame. If designed to exit to the side of the bus, the tailpipe extend at least 48.5 inches (51.5 inches if the body is to be 102 inches wide) outboard from the chassis centerline.

   a. On Types C and D vehicles, the tailpipe shall not exit beneath a fuel fill or emergency door exit.

   b. Type A and B chassis may be furnished with the manufacturer's standard tailpipe configuration.
   (Note: See also Bus Body Standards: TAILPIPE)

4. Exhaust system on a chassis shall be adequately shielded from the fuel system.

5. Muffler shall be constructed of corrosion-resistant material.

6. The exhaust system on vehicles equipped with a power lift unit may be routed to the left of the right frame rail to allow for the installation of a power lift unit on the right side of the vehicle.

FENDERS, FRONT-TYPE C VEHICLES

1. Total spread of outer edges of front fenders, measured at fender line, shall exceed total spread of front tires when front wheels are in straight-ahead position.

2. Front fenders shall be properly braced and free from any body attachments.

FRAME

1. Frame or equivalent shall be of such design and strength characteristics as to correspond at least to standard practice for trucks of the same general load characteristics which are used for highway service.

2. Any secondary manufacturer that modifies the original chassis frame shall guarantee the performance of workmanship and materials resulting from such modification.

3. Frames shall not be modified for the purpose of extending the wheel base.

4. Holes in top or bottom flanges or side units of the frame, and welding to the frame, shall not be permitted except as provided or accepted by chassis manufacturer.

5. Frame lengths shall be the established mutual design criteria for the vehicle.

FUEL TANK

1. Fuel tank or tanks have a minimum 30 gallon capacity shall be provided by the chassis manufacturer. The tank shall be filled and vented from the outside of the passenger compartment, in a location where accidental fuel spillage will not drip or drain on any part of the exhaust system.

2. Fuel lines shall be mounted to obtain maximum possible protection from the chassis frame.

3. Fuel tank installation shall be in accordance with all Federal Motor Vehicle Safety Standards in effect on the date of manufacture of the bus.

    a. Fuel tank(s) may be mounted between the chassis frame rails or outboard of the frame rails on either the left or right side of the vehicle.

4. The actual draw capacity of each fuel tank shall be a minimum of 83% of the tank capacity.

5. Installation of alternative fuel systems, including fuel tanks and piping from tank or engine, shall comply with all applicable fire codes and applicable Federal Motor Vehicle Safety Standards in effect on the date of manufacture of the bus.

    a. Installation of LPG tanks shall comply with National Fire Protection Association (NFPA).

GOVERNOR

1. When engine is remotely located from driver, the governor shall be set to limit engine speed to maximum revolutions per minute recommended by engine manufacturer, and a tachometer shall be installed so the engine speed may be known to the driver.

HEATING SYSTEM, PROVISION FOR

1. The chassis engine shall have plugged openings for the purpose of supplying hot water for the bus heating system. The openings shall be suitable for attaching 3/4 inch pipe thread/hose connector. The engine shall be capable of supplying water having a temperature of at least 170 degrees Fahrenheit at a flow rate of 50 pounds/per minute at the return end of 30 feet of one inch inside diameter automotive hot water beater hose. (SBNG Standard No. 001-Standard Code for Testing and Rating Automotive Bus Hot Water Heating and Ventilating Equipment.)

HORN

1. Bus shall be equipped with horn or horns of standard make with each horn capable of producing a complex sound in bands of audio frequencies between 250 and 2,000 cycles per second and tested in accordance with SAE J-377.

INSTRUMENTS AND INSTRUMENT PANEL

1. Chassis shall be equipped with the following instruments and gauges. (Lights in lieu of gauges are not acceptable, except as noted):

    a. Speedometer

    b. Odometer which will give accrued mileage (to seven digits), including tenths of miles.

    c. Voltmeter

        1) Ammeter with graduated charge and discharge, with ammeter and its wiring compatible with generating capacities, is permitted in lieu of voltmeter.

    d. Oil pressure gauge

    e. Water temperature gauge

    f. Fuel gauge

    g. Upper beam headlight indicator

    h. Brake indicator gauge (vacuum or air)

        1) Light indicator in lieu of gauge is permitted on vehicle equipped with hydraulic-over-hydraulic brake system.

    i. Turn signal indicator

    j. Glow-plug indicator light where appropriate

2. All instruments shall be easily accessible for maintenance and repair.

3. Instruments and gauges shall be mounted on the instrument panel so that each is clearly visible to the driver while seated in a normal driving position.

4. Instrument panel shall have lamps of sufficient candlepower to illuminate all instruments and gauges and shift indicator for automatic transmission.

5. Multi-function gauge (MFG)

    a. The driver must be able to manually select any displayable function of the gauge on a MFG whenever desired.

    b. Whenever an out-of-limits condition occurs, which would be displayed on one or more functions of a MFG, then the MFG controller should automatically display this condition on the instrument cluster. This should be in the form of an illuminated tell-tale warning lights as well as having the MFG automatically display the out-of-limits indications. Should two or more functions display on the MFG go out-of-limits simultaneously, then the MFG should automatically sequence between those functions continuously until the condition(s) is corrected.

    c. The use of a MFG does not relieve the requirements for audible warning devices, where required.

OIL FILTER

1. An oil filter with a replacement element shall be provided and connected by flexible oil lines if not a built-in or an engine-mounted design. The oil filter shall have a capacity of at least one (1) quart.

OPENINGS

1. All openings in the floorboard or firewall between chassis and passenger compartment, such as for gearshift selector and parking brake lever, shall be sealed.

PASSENGER LOAD

1. Actual gross vehicle weight (GVW) is the sum of the chassis weight plus the body weight, plus the driver's weight, plus total seated pupil weight.

    a. For the purposes of calculation, the driver's weight is 150 pounds.

    b. For the purposes of calculation, the pupil weight is 120 pounds per pupil.

2. Actual gross vehicle weight (GVW) shall not exceed the chassis manufacturer's GVWR for the chassis nor shall the actual weight carried on any axle exceed the chassis manufacturer's GAWR.

3. Manufacturer's (GVWR) shall be furnished in duplicate (unless more are requested) by manufacturers to the district transportation jurisdiction upon request.

POWER AND GRADE ABILITY

1. GVWR shall not exceed 185 pounds per published net horsepower of the engine at the manufacturer's recommended maximum number of revolutions per minute.

RETARDER SYSTEM (Optional equipment)

1. Retarder system, if used, should maintain the speed of the fully loaded school bus at 19.0 mph or 30 km/hr on a 7% grade for 3.6 miles or 6 km.

ROAD SPEED CONTROL

1. When it is desired to accurately control vehicle maximum speed a vehicle speed limiter may be utilized.

SHOCK ABSORBERS

1. The bus shall be equipped with a double-action shock absorbers compatible with manufacturer's rated axle capacity at each wheel location.

STEERING GEAR

1. The steering gear shall be approved by the chassis manufacturer and designed to ensure safe and accurate performance when the vehicle is operated with maximum load and at maximum speed.

2. If external adjustments are required, steering mechanism shall be accessible to accomplish same.

3. No changes shall be made in the steering apparatus which are not approved by the chassis manufacturer.

4. There shall be a clearance of at least 2 inches between the steering wheel and cowl, instrument panel, windshield, or any other surface.

5. Power steering is required and shall be of the integral type with integral valves.

6. The steering system shall be designed to provide a means for lubrication of all wear-points, if wear-points are not permanently lubricated.

SUSPENSION SYSTEMS

1. The capacity of springs or suspension assemblies shall be commensurate with chassis manufacturer's GVWR rating.

2. Leaf rear springs shall be a progressive rate or multi-stage design. Front leaf springs shall have a stationary eye at one end and shall be protected by a wrapped leaf in addition to the main leaf.

THROTTLE

1. The force required to operate the throttle shall not exceed 16 pounds throughout the full range of accelerator pedal travel.

TIRES and WHEELS

1. Tires and rims of the proper size and tires with a load rating commensurate with chassis manufacturer's gross vehicle weight rating shall be provided. The use of multi-piece rims and/or tube-type tires shall not be permitted on any school bus ordered after December 31, 1995.

2. Dual rear tires shall be provided on Type A-2, Type B, Type C, and Type D school buses.

3. All tires on a vehicle shall be of the same size, and the load range of the tires shall meet or exceed the GVWR as required by FMVSS 120.

4. If the vehicle is equipped with a spare tire and rim assembly, it shall be the same size as those mounted on the vehicle.

5. If a tire carrier is required, it shall be suitably mounted in an accessible location outside the passenger compartment.

TRANSMISSION

1. Automatic transmissions shall have no fewer than three forward speeds and one reverse speed. The mechanical selector shall provide a detent between each gear position when the gear selector quadrant and shift selector are not steering column mounted.

2. On manual transmissions, second gear and higher shall be synchronized except when incompatible with engine power. A minimum of three forward speeds and one reverse speed shall be provided.

3. An electronic control or similar device may be installed to ensure that automatic transmissions cannot accidentally be moved out of the neutral or park gear position while the driver is not in the driver's seat.

TURNING RADIUS

1. A Chassis with a wheelbase of 264 inches or less shall have a right and left turning radius of not more than 42 1/2 feet, curb to curb measurement.

2. A chassis with a wheelbase of 265 inches or more shall have a right and left turning radius of not more than 44 1/2 feet, curb to curb measurement.

UNDERCOATING

1. The chassis manufacturers or their agent shall coat the undersides of steel or metallic-constructed front fenders with a rust-proofing compound for which compound manufactures have issued notarized certification of compliance to chassis builder that the compound meets or exceeds all performance and qualitative requirements of paragraph 3.4 of Federal Specification TT-C-520B, using modified tests.

BUS BODY SPECIFICATIONS

AISLE

1. All emergency doors shall be accessible by a 12 inch minimum aisle. Aisle shall be unobstructed at all times by any type of barrier, seat, wheelchair or tiedown, unless a flip seat is installed and occupied. A flip seat in the unoccupied (up) position shall not obstruct the 12" minimum aisle to any side emergency door.

2. The seat backs shall be slanted sufficiently to give aisle clearance of 15" at tops of seat backs.

BACK-UP WARNING ALARM

1. An automatic audible alarm shall be installed behind the rear axle and shall comply with the published Backup Alarm Standards (SAE J994B), providing a minimum of 112 DBA.

BATTERY

1. Battery is to be furnished by chassis manufacturer.

2. When the battery is mounted as described in the chassis section, the body manufacturer shall securely attach the battery on a slide-out or swing-out tray in a closed, vented compartment in the body skirt, so that the battery is accessible for convenient servicing from the outside. Battery compartment door or cover shall be hinged at front or top, and secured by an adequate and conveniently operated latch or other type fastener. Battery compartment not required on type A1 buses.

3. Buses shall be equipped with a battery shut-off switch. The switch is to be placed in a location not readily accessible to the passengers.

BUMPER (FRONT)

1. On a Type "D" school bus, if the chassis manufacturer does not provide a bumper, it shall be provided by the body manufacturer. The bumper will conform to the standards in the chassis section.

BUMPER (REAR)

1. Bumper shall be pressed steel channel at least 3/16 inches thick or equivalent strength material except Type A buses, and shall be a minimum of 8 inches wide (high) on Type A-1

and a minimum of 9 1/2 inches wide (high) on Types A2, B, C and D buses and of sufficient strength to permit being pushed by another vehicle without permanent distortion.

2. Bumper shall be wrapped around back corners of the bus. It shall extend forward at least 12 inches, measured from the rear-most point of the body at the floor line and shall be flush mounted to body side or protected with an end panel.

3. Bumper shall be attached to the chassis frame in such a manner that it may be easily removed. It shall be so braced as to withstand impact from a rear or side impact. It shall be so attached as to discourage hitching rides.

4. Bumper shall extend at least 1 inch beyond the rear-most part of body surface measured at the floor line.

CEILING

1. See insulation and Interior, Body Section.

CERTIFICATION

1. Body manufacturer, shall, upon request, certify to the state agency having pupil transportation jurisdiction, that their product meets state standards on items not covered by certification issued under requirements of the National Traffic and Motor Vehicle Safety Act.

CHAINS (TIRE)

1. See wheelhousing, Body section.

COLOR

1. The school bus body shall be painted National School Bus Yellow (NSBY).

2. The body exterior paint trim shall be black, and may include exterior windows and frame posts up to and including doors.

3. Optionally the roof of the bus may be painted white, except that front and rear roof caps shall remain National School Bus yellow.

CONSTRUCTION

1. **Side Intrusion Test:** The bus body shall be so constructed to withstand an Intrusion force equal to the curb weight of the vehicle; but not to exceed twenty thousand (20,000) pounds,

whichever is less. Each vehicle shall be capable of meeting this requirement when tested in accordance with the procedures set forth below;

The complete body structure, or a representative seven (7) body section mock up, with seats installed shall be load tested at a location twenty four inches (24") plus or minus two inches (2") above the floor line, with a maximum 10 inch diameter cylinder, forty eight inches (48") long, mounted in a horizontal plane.

The cylinder shall be placed as close as practical to the mid point of the tested structure, spanning two internal vertical structural members. The cylinder shall be statically loaded to the required force of curb weight or twenty thousand (20,000) pounds, whichever is less, in a horizontal plane with the load applied from the exterior toward the interior of the test structure. Once the minimum load has been applied, the penetration of the loading cylinder into the passenger compartment shall not exceed a maximum of ten inches (10") from its original point of contact. There can be no separation of lapped panels or construction joints. Punctures, tears, or breaks in the external panels are acceptable; but are not permitted on any adjacent interior panel. Body companies shall certify with this intrusion requirement; including test results, if requested.

2. Construction shall be reasonably dust-proof and watertight.

CROSSING CONTROL ARM

This school bus standard applies to all school buses except those used solely to transport students with special needs who are manually loaded and unloaded.

1. Buses shall be equipped with a crossing control arm mounted on the right side of the front bumper. This arm when opened shall extend in a line parallel with the body side and positioned on a line with the right side wheels.

2. All components of the crossing control arm and all connections shall be weatherproofed.

3. The crossing control arm shall incorporate system connectors (electrical, vacuum, or air) at the gate and shall be easily removable to allow for towing of the bus.

4. The crossing control arm shall meet or exceed SAE Standard JI 133.

5. The crossing control arm shall be constructed of noncorrosive or nonferrous material or treatment in accordance with the body sheet metal standard. (see Metal Treatment)

6. There shall be no sharp edges or projections that could cause hazard or injury to students.

7. The crossing control arm shall extend minimum 70 inches (measured from the bumper at the arm assembly attachment point) when in the extended position.

8. The crossing control arms shall extend simultaneously with the stop arm(s) by means of the stop arm controls.

9. An automatic recycling interrupt switch should be installed for temporary disabling of the crossing control arm.

DEFROSTERS

1. Defrosting and defogging equipment shall direct a sufficient flow of heated air onto the windshield, the window to the left of the driver, and the glass in the viewing area directly to the right of the driver to eliminate frost, fog and snow.

2. The defrosting system shall conform to SAE standards J381 and J382.

3. The defroster and defogging system shall be capable of furnishing heated outside ambient air, except the part of the system furnishing additional air to the windshield, entrance door and stepwell may be of the recirculating air type.

4. Auxiliary fans are not considered defrosting or defogging systems.

5. Portable heaters shall not be used.

DOORS

1. Service door:

    a. Service door shall be in the driver's control, and designed to afford easy release and provide a positive latching device on manual operating doors to prevent accidental opening. When a hand lever is used, no part shall come together that will shear or crush fingers. Manual door controls shall not require more than 25 pounds of force to operate at any point throughout the range of operation, as tested on a ten percent grade, both uphill and downhill.

    b. Service door shall be located on the right side of the bus, opposite and within direct view of driver.

    c. Service door shall have a minimum horizontal opening of 24 inches and a minimum vertical opening of 68 inches. Type A-1 vehicles shall have a minimum opening area of 1200 square inches.

    d. Service door shall be a split-type, sedan-type, or jack-knife type. (Split-type door includes any sectioned door which divides and opens inward or outward.) If one section of a split-type door opens inward and the other opens outward, the front section shall open outward.

e. Lower, as well as, upper door panels shall be of approved safety glass. Bottom of each lower glass panel shall not be more than 10 inches from the top surface of bottom step. Top of each upper glass panel shall not be more than 3 inches from the top of the door. Type A vehicles shall have an upper panel (windows) of safety glass with an area of at least 350 square inches.

f. Vertical closing edges on split-type or folding-type entrance doors shall be equipped with flexible material to protect children's fingers. Type A-1 vehicles may be equipped with chassis manufacturer's standard door.

g. There shall be no door to the left of driver on Type B, C or D vehicles. All type A vehicles may be equipped with chassis manufacturer's standard door.

h. All doors shall be equipped with padding at the top edge of each door opening. Padding shall be at least 3 inches wide and 1 inch thick and extend the full width of the door opening.

i. On power operated service doors the emergency release valve, switch or device to release the service door must be placed above or to the immediate left or right of the service door and clearly labeled.

EMERGENCY EXITS

1. All installed Emergency Exits shall comply with the requirements of FMVSS 217 and all of the requirements of this document.

2. **Emergency door requirements:**

   a. Upper portion of the emergency door shall be equipped with approved safety glazing, exposed area of which shall be at least 400 square inches. The lower portion of the rear emergency doors on Types A-2, B, C, and D vehicles shall be equipped with a minimum of 350 square inches of approved safety glazing.

   b. There shall be no steps leading to an emergency door.

   c. The emergency door(s) shall be equipped with padding at top edge of each door opening. Padding shall be at least 3 inches wide and 1 inch thick, and extend the full width of the door opening.

   d. There shall be no obstruction higher that 1/4 inch across the bottom of any emergency door opening.

   e. The rear emergency window shall have an assisted lifting device that will aid in lifting and holding the rear emergency window open.

3. **Emergency Exit requirements:**

   Types A, B, C, and D vehicles shall be equipped with a total number of emergency exits as follows for the indicated capacities of vehicles. Exits required by FMVSS 217 may be included to comprise the total number of exits specified.

   0 to 41 Passenger = 1 emergency exit per side and 1 roof hatch.

   43 to 78 Passenger = 2 emergency exits per side and 2 roof hatches.

   79 to 90 Passenger = 3 emergency exits per side and 2 roof hatches.

   Side emergency exit windows when installed may vertically hinged on the forward side of the window. No side emergency exit window will be located above a stop arm.

EMERGENCY EQUIPMENT

1. **Fire Extinguisher:**

   a. The bus shall be equipped with at least on UL-approved pressurized, dry chemical fire extinguisher. Extinguisher shall be mounted (secured) in a bracket, located in the driver's compartment and readily accessible to the driver and passengers. A pressure gauge shall be mounted on the extinguisher and be easily read without moving the extinguisher from its mounted position.

   b. The fire extinguisher shall have a total rating of 2A10BC or greater. The operating mechanism shall be sealed with a type of seal that will not interfere with the use of the fire extinguisher.

2. **First-Aid Kit:** The bus shall have a removable moisture-proof and dust-proof first aid kit in an accessible place in the driver's compartment. It shall be properly mounted (and secured) and identified as a first aid kit. The location for the first aid kit shall be marked.

   Minimum contents include:

   2 1" x 2 1/2 yards adhesive tape rolls;
   24 Sterile gauze pads;
   50 3/4" x 3" adhesive bandages;
   8 2" bandage compress;
   10 3" bandage compress;
   2 2" x 6' sterile gauze roller bandages;
   2 Non-sterile triangular bandages minimum 39" x 35" x 54" with 2 safety pins;
   3 Sterile gauze pads 36" x 36";
   3 Sterile eye pads;
   1 rounded-end scissors;
   1 pair Medical Examination gloves;

1 Mouth-to-mouth airway;

3. **Body Fluid Clean-Up Kit:** Each school bus shall have a removable and moisture-proof body fluid clean-up kit accessible to the driver. It shall be properly mounted and identified as a body fluid clean-up kit.

   Minimum contents include:

   1 Packet of a solution that contains a red-10 dye and that is used to solidify bodily fluids;
   2 Antiseptic wipes;
   1 Antimicrobial wipe for leasing hands;
   1 Disposal germicidal wipe;
   1 Pair of latex gloves
   1 Safety shield; and
   1 Red bag that is marked "biohazard"

   *As used in this section, "biohazard" means a biological agent that my be hazardous to person or the environment.

4. **Warning Devices:** Each school bus shall contain at least three (3) reflectorized triangle road warning devices mounted in an accessible place. These devices must meet requirements in FMVSS 125.

5. **Spare fuses:** At least one (1) spare fuse or other load protective devices, if the devices used are not of a reset type for each kind and size used.

6. Any of the **emergency equipment** may be mounted in an enclosed compartment, provided the compartment is labeled in not less than one inch letters, identifying each piece of equipment contained therein:

FLOORS

1. Floor in under-seat area, including tops of wheelhousings, driver's compartment and toeboard, shall be covered with rubber floor covering or equivalent, having a minimum over all thickness .125". The driver's area on all Type A buses maybe manufacturer's standard flooring and floor covering.

2. Floor covering in aisles shall be of aisle-type rubber or equivalent, wear-resistant and ribbed. Minimum overall thickness shall be .187" measured from tops of ribs.

3. Floor covering must be permanently bonded to floor and must not crack when subjected to sudden changes in temperature. Bonding or adhesive material shall be waterproof and shall be a type recommended by the manufacturer of floor-covering material. All seams must be sealed with waterproof sealer.

4. On Types B, C and D buses a flush mounted screw-down plate that is secured and sealed shall be provided to access the fuel tank sending unit.

HEATING and AIR CONDITIONING SYSTEMS

1. **Air Conditioning (Optional):** The specifications are applicable to all types of school buses that my be equipped with air conditioning. This section is divided into two parts. Part a covers Performance Specifications; Part b covers other requirements applicable to all buses.

2. **Performance Specifications:**

   a. The installed air conditioning system should cool the interior of the bus to 80 degrees Fahrenheit measured at a minimum of three points, located four feet above the floor at the longitudinal centerline of the bus. The three points shall be 1) near the driver's location, 2) at the mid point of the body, and 3) 2 feet forward of the emergency door, or, for Type D rear engine buses, two feet forward of the end of the aisle.

   The test conditions under which the above performance must be achieved shall consist of 1) placing the bus in a room (such as a paint booth) where ambient temperature can be maintained at 100 degrees Fahrenheit, 2) heat soaking the bus at 100 degrees Fahrenheit with windows open for at least on hour, and 3) closing windows turning on the air conditioner with engine at chassis manufacturer's recommended high idle speed, and cooling the interior of the bus to 80 degrees Fahrenheit or lower within a maximum of 30 minutes while maintaining 10 degrees Fahrenheit outside temperature.

   Alternately, and at the user's discretion, this test may be performed under actual summer conditions, which consist of temperatures above 85 degrees Fahrenheit, humidity above 50 percent with normal sun loading of the bus and engine at manufacturer's recommended high idle speed. After a minimum of 1 hour of head soaking, the system shall be turned on and must provide a minimum 20 degree temperature drop in the 30 minute time limit.

   The manufacturer shall provide facilities for the user to user's representative to confirm that a pilot model of each bus design meets the above performance requirements.

3. **Other requirements:**

   a. Evaporator cases, lines and ducting (as equipped) shall be designed such that all condensation is effectively drained to the exterior of the bus below floor level under all conditions of vehicle movement without leakage on any interior portion of bus.

   b. Any evaporator or ducting system shall be designed and installed so as to be free of injury-prone projections or sharp edges. Any ductwork shall be installed so that exposed edges face the front of the bus and do not present sharp edges and meet all applicable requirements of current FMVSS including head impact zone.

c. On special equipped school buses, evaporator and ducting (if used) shall be placed high enough that they will not obstruct occupant securement should strap upper attachment points. This clearance shall be provided along entire length of the passenger area on both sides of the bus interior. To allow for potential retrofitting of new wheelchair positions and occupant securement devices throughout the bus.

d. Body man be equipped with the full body insulation including sidewalls, roof firewall, rear, inside bows, and plywood or composite floor insulation to aid in head dissipation and reflection.

e. All glass (windshield, service and emergency doors, side and rear windows) may be equipped with maximum integral tinting allowed by Federal, State, or ANSI standards for respective locations, except that windows rear of the driver's compartment if tinted, shall have approximately 28% light transmission.

f. Electrical Requirements-Manufacturer shall be responsible for adding electric al generating capacity to accommodate the additional electrical demands imposed by the air conditioning system.

g. Roofs may be painted white to aid in heat dissipation.

4. **Heating System:**

a. Heater shall be hot water and/or combustion type.

b. If only one heater is used, it shall be fresh-air or combination fresh-air and re-circulation type.

c. If more than one heater is used, additional heaters may be recirculating air type.

d. The heating system shall be capable of maintaining bus interior temperatures as specified in SAE test procedure J2233.

e. Auxiliary fuel-fired heating systems are permitted, provided they comply with the following:

1) The auxiliary heating system fuel shall utilize the same type fuel as specified for the vehicle engine.

2) Heater(s) may be direct hot air or connected to the engine's coolant system.

3) Auxiliary heating system, when connected to the engine's coolant system may be used to preheat the engine coolant or preheat and add supplementary heat to the bus's heating system.

4) Auxiliary heating systems must be installed pursuant to the manufacturer's recommendations and shall not direct exhaust in such a manner that will endanger bus passengers.

5) Auxiliary heating systems which operate on diesel fuel shall be capable of operating on #1, #2 or blended diesel fuel without the need for system adjustment.

6) The auxiliary heating system shall be low voltage.

7) Auxiliary heating systems shall comply with all applicable FMVSS standards, including FMVSS 301, as well as, SAE test procedures.

5. All forced air heaters installed by body manufacturers shall bear a name plate that indicates the heater rating accordance with SBMTC Standard No. 001. The plate shall be affixed by the heater manufacturer and shall constitute certification that the heater performance is as shown on the plate.

6. Heater hoses shall be adequately supported to guard against excessive wear due to vibration. The hoses shall not dangle or rub against the chassis or any sharp edges and shall not interfere with or restrict the operation of any engine function. Heater hoses shall conform to SAE Standard J20c. Heater lines on the interior of bus shall be shielded to prevent scalding of the driver or passengers.

7. Each hot water system installed by a body manufacturer shall include one shut-off valve in the pressure line and one shut-off valve in the return line with both valves at the engine in an accessible location, except that on all Types A and B buses, the valves may be installed in another accessible location.

8. There shall be a water flow regulating valve installed in the pressure line for convenient operation by the driver while seated.

9. All combustion heaters shall be in compliance with current Federal Motor Carrier Safety Regulations.

10. Accessible bleeder valves shall be installed in an appropriate place in the return lines of body company-installed heaters to remove air from the heater lines.

11. Access panels shall be provided to make heater motors, cores, and fans readily accessible for service. Outside access panel may be provided for the driver's heater.

HINGES

1. All exterior metal door hinges which do not have stainless steel, brass, or nonmetallic hinge pins or other designs that prevent corrosion shall be designed to allow lubrication to be channeled to the center 75% of each hinge loop without disassembly.

IDENTIFICATION

1. Body shall bear words "SCHOOL BUS" in black letters at least 8 inches high on both front and rear of body or on signs attached thereto. Lettering shall be placed as high as possible without impairment of its visibility. Letters shall conform to "Series B" of Standard Alphabets for highway signs. "SCHOOL BUS" lettering shall have a reflective background, or as an option, may be illuminated by backlighting.

2. Required lettering and numbering shall include:

    a. District or company name or owner of the bus shall be displayed at the beltline.

    b. Bus identification number shall be displayed on the sides, on the rear, and on the front.

3. Other lettering , numbering, or symbols which may be displayed on the exterior of the bus, shall be limited to:

    a. Bus identification number on the top of the bus, in addition to required numbering on sides, rear, and front.

    b. The location of the battery(ies) identified by the word "BATTERY" or "BATTERIES" on the battery compartment door in 2 inch lettering.

    c. Symbols or letters near the service door displaying information for identification by the students of the bus or route served. Such symbols or lettering, if used, (total display) shall not exceed 64 square inches in size.

    d. Manufacturer, dealer or school identification or logos.

    e. Symbols identifying the bus as equipped for or transporting students with special needs (see Specially Equipped School Bus section)

    f. Lettering on the rear of the bus relating to school bus flashing signal lamps or railroad stop procedures.

    g. Identification of fuel type shall be in 2 inch lettering adjacent to the fuel filler opening.

    h. May include other items related to maintenance and safety. Identification shall not exceed 2 inches.

INSIDE HEIGHT

1. Inside body height shall be 72 inches or more at any point on longitudinal centerline from front vertical bow or rear vertical bow. Inside body height of Type A-2 buses shall be 62 inches or more.

INSULATION (optional)

1. If thermal insulation is specified, it shall be fire-resistant, UL approved, with minimum R-value of 5.5 insulation shall be installed to prevent sagging.

2. If floor insulation is required, it shall be 5 ply nominal 5/8 inch thick plywood, and it shall equal or exceed properties of the exterior-type softwood plywood, C-D Grade as specified in standard issued by U.S. Department of Commerce. When plywood is used, all exposed edges shall be sealed. Type A-1 buses may be equipped with nominal 1/2" thick plywood or equivalent material meeting above requirements. Equivalent may be used to replace plywood providing it has an equal or greater R value, deterioration and moisture resistance properties.

INTERIOR

1. Interior of bus shall be free of all unnecessary projections to minimize the potential for injury. This standard requires inner lining on ceilings and walls. If ceiling is constructed to contain lapped joints, forward panel shall be lapped by rear panel and exposed edges shall be beaded, hemmed, flanged, or otherwise treated to minimize sharp edges. Buses may be equipped with storage compartment for tools, tire chains, and/or tow chains

2. Interior overhead storage areas may be provided if they meet the head protection requirements of FMVSS 222, and the maximum rated weight capacity is clearly displayed.

3. The driver's area forward of the foremost padded barriers will permit the mounting of required safety equipment and vehicle operation equipment.

4. Every school bus shall be constructed so that the noise level taken at the rear of the occupant nearest to the primary vehicle noise source shall not exceed 85 dba when tested according to the procedure found in the Appendix B.

LAMPS and SIGNALS

1. Interior lamps shall be provided which adequately illuminate aisle and stepwell. Stepwell light shall be illuminated by a service door operated switch, to illuminate only when headlights and clearance lights are on and service door is open.

2. Body instrument panel lights shall be controlled by an independent rheostat switch.

3. **School bus alternately flashing signal lamps:**

    a. Bus shall be equipped with two red lamps at the rear of vehicle and two red lamps at the front of the vehicle.

b. In addition to the four red lamps described above, four amber lamps shall be installed so that one amber lamp is located near each red signal lamp, at same level, but closer to vertical centerline of bus. The system of red and amber signal lamps shall be wired so that amber lamps are energized manually, and red lamps are automatically energized (with amber lamps being automatically de-energized) when stop signal arm is extended or when bus service door is opened. An amber pilot light and red pilot light shall be installed adjacent to the driver controls for the flashing signal lamp to indicate to the driver which lamp system is activated.

c. Area around lens of alternately flashing signal lamp(s) extending outward from the edge of the lamps 3 inches (+/- 1/4 inch) to the sides and top, and minimum 1 inch to the bottom shall be black in color on body of roof area against which signal lamp is seen (from the distance of 500 feet along axis of vehicle). Visors or hoods, black in color, with a minimum depth of 4 inches may be provided.

d. Red lamps shall flash at any time the stop signal arm is extended.

e. All flashers for alternately flashing red and amber signal lamps shall be enclosed in the body in a readily accessible location.

4. **Turn signal and stop/tail lamps:**

a. Bus body shall be equipped with amber rear turn signal lamps that are at least 7 inches in diameter or if a shape other than round, a minimum 38 square inches of illumination area and meet SAE specifications. These signal lamps must be connected to the chassis hazard warning switch to cause simultaneous flashing of turn signal lamps when needed as vehicular traffic hazard warning. Turn signal lamps when needed as vehicular traffic hazard warning. Turn signal lamps are to be placed as wide apart as practical and their centerline shall be a maximum of 12 inches below the rear window. Type A-1 conversion vehicle lamps must be at least 21 square inches in lens area and be in manufacturer's standard color.

b. Buses shall be equipped with amber side-mounted turn signal lights. The turn signal lamp on the left side shall be mounted rearward of the stop signal arm and the turn signal lamp on the right side shall be mounted rearward of the service door.

c. Buses shall be equipped with four combination red stop/tail lamps:

1) Two combination lamps with a minimum diameter of 7 inches, or if a shape other than round, a minimum 38 square inches of illuminated area shall be mounted on the rear of the bus just inside the turn signal lamps.

2) Two combination lamps with a minimum diameter of 4 inches, or if a shape other than round, a minimum 12 square inches of illuminated area shall be placed on the rear of the body between the beltline and the floor line. Rear license plate lamp may

be combined with one lower tail lamp. Stop lamps shall be activated by the service brakes and shall emit a steady light when illuminated. Type A-1 buses with bodies supplied by chassis manufacturer may have manufacturer's standard stop and tail lamps.

5. On buses equipped with a monitor for the front and rear lamps of the school bus, the monitor shall be mounted in full view of the driver. If the full circuit current passes through the monitor, each circuit shall be protected by a fuse or circuit breaker against any short circuit or intermittent shorts.

6. An **optional white flashing strobe light** may be installed on the roof of a school bus, not to exceed 1/3 the body length forward from the rear of the roof edge. Light shall have a single clear lens emitting light 360 degrees around its vertical axis and may not extend above the roof more than a maximum legal height. A manual switch and a pilot light shall be included to indicate when light is in operation. Optionally, the strobe light may be mounted on the roof in the area directly over the driver's side crash barrier, and may be wired to activate with the amber alternately flashing signal lamps, continuing through the full loading or unloading cycle, with an override switch to allow activation of the strobe at any time for use in inclement weather.

7. **Backup lamps:** Bus body shall be equipped with two white rear backup lamp signals that are at least 4 inches in diameter or, if a shape other than round, a minimum of 13 square inches of illuminated area, meeting SAE specifications. If backup lamps are placed on the same line as the brake lamps and turn signal lamps, they shall be to the inside.

METAL TREATMENT

1. All metal used in construction of bus body shall be zinc coated or aluminum coated or treated by equivalent process before bus is constructed. Included are such items as structural members, inside and outside panels, door panels and floor sills. Excluded are such items as door handles, grab handles, interior decorative parts and other interior plated parts.

2. All metal parts that will be painted shall be, in addition to above requirements, chemically cleaned, etched, zinc-phosphate-coat and zinc-chromate or epoxy primed or conditioned by equivalent process.

3. In providing for these requirements, particular attention shall be given to lapped surfaces, welded connections of structural members, cut edges punched or drilled hole areas in sheet metal, closed or box sections, unvented or undrained areas and surfaces subjected to abrasion during vehicle movement.

4. As evidence that above requirements have been met, sample of materials and sections used in construction of the bus body subjected to 1,000-hour salt spray test a provided for in latest revision of ASTM Standard B-117 shall not lose more than 10 percent of material by weight.

MIRRORS

1. Interior mirrors shall be either clear view laminated glass or clear view glass bonded to a backing which retains the glass in the event of breakage. Mirror shall have rounded corners and protected edges. All Type A buses shall have a minimum of a 6 inch x 16 inch mirror and Types B, C, and D buses shall have a minimum of a 6 inch x 30 inch mirror.

2. Each school bus shall be equipped with exterior mirrors meeting the requirements of FMVSS 111. Mirrors shall be easily adjustable, but shall be rigidly braced so as to reduce vibration.

3. Heated external mirrors may be used.

MOUNTING

1. Chassis frame shall support rear body cross member. Bus body shall be attached to chassis frame at each main floor sill, except where chassis components interfere, in such a manner as to prevent shifting or separation of the body from the chassis under severe operating conditions.

2. Isolators shall be installed at all contact points between body and chassis frame on Types A-I, B, C, and D buses, and shall be secured by a positive means to the chassis frame or body so that it will bit be displaced under severe operating conditions.

OVERALL LENGTH

1. Overall length of bus shall not exceed 45 feet, excluding accessories.

OVERALL WIDTH

1. Overall width of bus shall not exceed 102 inches, excluding accessories,

PUBLIC ADDRESS SYSTEM

1. Buses may be equipped with an AM/FM/Audio and/or public address system having interior and exterior speakers.

2. No internal speakers, other than driver's communication systems may be installed within four feet of the driver's seat back in its rearmost upright position.

REFLECTIVE MATERIAL (as illustrated in Appendix C)

1. Front and/or rear bumper may be marked diagonally 45 degrees down to centerline of pavement with 2 inches $\pm$ 1/4 inch wide strips of non-contrasting reflective material.

2. Rear of bus body shall be marked with strips of reflective NSBY material to outline the perimeter of the back of the bus using material which conforms with the requirements of FMVSS 571.131 Table 1. The perimeter marking of rear emergency exits per FMVSS 217 and/or the use of reflective "SCHOOL BUS" signs partially accomplish the objective of this requirement. To complete the perimeter marking of the back of the bus, strips of at least 1 3/4 inch reflective NSBY material shall be applied horizontally above the rear windows and above the rear bumper extending from the rear emergency exit perimeter marking outward to the left and right corners or the bus; and vertical strips shall be applied at the corners connecting these horizontal strips.

3. "SCHOOL BUS" signs, if not of lighted design, shall be marked with reflective NSBY material comprising background for lettering of the front and/or rear "SCHOOL BUS" signs.

4. Sides of bus body shall be marked with reflective NSBY material at least 1 3/4 inch in width, extending the length of the bus body and located (vertically) between the floor line and the beltline. NOTE: Reflectivity of stop signal arm is to be addressed under Stop Signal Arm Section. Signs. If used, placed on the rear of the bus relating to school bus flashing signal lamps or railroad stop procedure may be of reflective material as specified by each state.

RUB RAILS

1. There shall be one rub rail located on each side of bus at seat cushion level which shall extend from rear side of entrance door completely around bus body (except emergency door or any maintenance access door) to point of curvature near outside cowl on left side.

2. There shall be one additional rub rail located on each side at or no more than 10 inches above the floor line which shall cover the same longitudinal area as upper rub rail, except at wheelhousings, and shall extend only to radii of right and left rear corners.

3. Both rub rails shall be attached at each body post and all other upright structural members.

4. Both rub rails shall be 4 inches or more in width in their finished form, shall be of 16-gauge steel or suitable material of equivalent strength, and shall be constructed in corrugated or ribbed fashion.

5. Both rub rails shall be applied outside body or outside body posts. Pressed-in or snap-on rub rails do not satisfy this requirement. For Type A-1 vehicles using chassis manufacturer's body, or for Types A-2, B, C and D buses using rear luggage or rear engine compartment, rub rails need not extend around rear corners.

6. There shall be a rub rail or equivalent bracing located horizontally at the bottom edge of the body side skirts.

SEAT AND CRASH BARRIERS

Passenger Seating

1. All seats shall have a minimum cushion depth of 15 inches and comply with all requirements of FMVSS 222. School bus design capacities shall be in accordance with CFR 49 Part 571.3.

2. All restraining barriers and passenger seats shall be constructed with materials that enable them to meet the criteria contained in the School Bus Seats Upholstery Fire Block Test.

3. Each seat leg shall be secured to the floor by a minimum of two (2) bolts, washers, and nuts. Flange-head nuts may be used in lieu of nuts and washers, or seats may be track-mounted in conformances with FMVSS 222. If track seating is installed, the manufacturer shall supply minimum and maximum seat spacing dimensions applicable to the bus, which comply with FMVSS 222. This information shall be on a label permanently affixed to the bus.

4. All seat frames attached to the seat rail shall be fastened with two (2) bolts, washers and nuts or flange-headed nuts.

5. All school bus bodies including Type A bodies shall be equipped with restraining barriers which conform to FMVSS 222 for vehicles greater than 10,000 # GVWR.

6. Use of a flip seat at any side emergency door location in conformance with FMVSS 222, including required aisle width to side door, is acceptable. Any flip seat shall be free of sharp projections on the underside of the seat bottom. The underside of the flip-up seat bottoms shall be padded or contoured to reduce the possibility of snagged clothing or injury during use. Flip seats shall be constructed to prevent passenger limbs from becoming entrapped between the seat back and the seat cushion when in upright position. The seat cushion shall be designed to rise to a vertical position automatically when not occupied.

Pre School Age Seating

1. When installed, all passenger seats designed to accommodate a child or infant carrier seat shall comply with FMVSS 225. These seats shall be in compliance with NHTSA "Guidelines for the Safe Transportation of Pre-School Age Children in School Buses".

SEAT, DRIVERS

1. Driver's seat supplied by the body company shall be a high back seat with a minimum seat back adjustment of 15 degrees, not requiring the use of tools, and with a head restraint to accommodate of 95th percentile adult male, as defined in FMVSS 208. The driver's seat shall be secured with nuts, bolts, and washers or flanged-headed nuts.

2. Type A buses may use chassis manufacturer's standard driver's seat and base.

SEAT BELT FOR DRIVER

1. A Type 2 lap belt/shoulder harness seat belt shall be provided for the driver. The assembly shall be equipped with an emergency locking retractor (ELR) for the continuous belt system. On all buses except Type A equipped with standard chassis manufacturers driver's seat, the lap portion of the belt shall be guided or anchored to prevent the driver from sliding sideways under it. The lap/shoulder harness shall be designed to allow for easy adjustment in order to fit properly and effectively protect drivers varying from 5th percentile female to 95th percentile male.

STEERING WHEEL - See Chassis Section

STEPS

1. First step at service door shall be not less that 10 inches and not more than 14 inches from the ground when measured from top surface of the step to the ground, except that on Type D vehicles, the first step at the service door shall be 12 inches to 16 inches from the ground.

2. Step risers shall not exceed a height of 10 inches. When plywood is used on a steel floor or step, the riser height may be increased by the thickness of the plywood.

3. Steps shall be enclosed to prevent accumulation of ice and snow, except for 4 wheel drive buses.

4. Steps shall not protrude beyond the side body line.

5. At least one handrail shall be installed. The handrail(s) shall assist passengers during entry or egress, and be designed to minimize entanglement. All handrails must pass the NHTSA string and nut test as defined in appendix B.

STEP TREADS

1. All steps, including floor line platform area, shall be covered with 3/16 inch rubber floor covering or other materials equal in wear and abrasion resistance to top grade rubber.

2. Metal back of tread shall be permanently bonded to step tread material.

3. Steps, including floor line platform area, shall have a 1 1/2 inch nosing that contrasts in color by at least 70% measured in accordance with the contrasting color specification in 36 CFR Part 1192 ADA, Accessibility Guidelines for Transportation Vehicles.

4. Step treads should have the following characteristics:

a. Special compounding for good abrasion resistance and coefficient of friction of at least 0.6 for the step surface, and 0.8 for the step nosing.

b. Flexibility so that it can be bent around a 1/2 inch mandrel both at 130 degrees Fahrenheit and 20 degrees Fahrenheit without breaking, cracking, or crazing.

c. Show a durometer hardness 85 to 95.

STIRRUP STEPS

1. Unless the windshield and lamps are not easily accessible from the ground, there may be at least one folding stirrup step or recessed foothold and suitably located handles on each side of the front of the body for easy accessibility for cleaning. Steps are permitted in or on the front bumper, in lieu of the stirrup steps, if the windshield and lamps are easily accessible for cleaning from that position.

STOP SIGNAL ARM

1. The stop signal arm(s) shall comply with the requirements of FMVSS 131.

STORAGE COMPARTMENT (optional)

1. A storage container for tools, tire chains, and/or tow chains may be located either inside or outside the passenger compartment but, if inside, it shall have a cover (seat cushion may not serve this purpose) capable of being securely latched and fastened to the floor, convenient to either the service or emergency door.

SUN SHIELD

1. Interior adjustable transparent sun shield not less than 6 inches by 30 inches for Types B, C and D vehicles, with a finished and protected edges, shall be installed in a position convenient for use by driver.

2. On all Type A buses, the sun shield shall be manufacturer's standard.

TAILPIPE

1. Tailpipe may be flush with but shall not extend out more than 2 inches beyond perimeter of the body for side exit or the bumper for rear exit.

2. Tailpipe shall exit to the left of the emergency exit door in the rear of vehicle or to the left side of the bus. Tailpipe exit location on all Type A1, or B1 bus may be manufacturer's

standard. Tailpipe shall not exit beneath any fuel filler location or beneath any emergency door.

TOWING ATTACHMENT POINTS

1. Optional tow eyes, hooks, or other devices may be furnished on the rear and attached so they do not project beyond the rear bumper. Tow eyes or hooks attached to the chassis frame shall be furnished by either the chassis or body manufacturer. The installation shall be in accordance with the chassis manufacturer's specifications.

   Note: Type A buses are exempt from this requirement for from front tow hook or eyes.)

TRACTION ASSISTING DEVICES (Optional)

1. Where required or used, sanders shall:

   a. Be of hopper cartridge-valve type;

   b. Have a metal hopper with all interior surfaces treated to prevent condensation of moisture;

   c. Be of at least 100 pound (grit) capacity;

   d. Have cover on filler opening of hopper, which screws into place, sealing unit airtight;

   e. Have discharge tubes extending to front of each rear wheel under fender;

   f. Have no-clogging discharges tubes with slush-proof, non-freezing rubber nozzles;

   g. Be operated by an electric switch with telltale pilot light mounted on the instrument panel;

   h. Be exclusively driver controlled;

   i. Have gauge to indicate that hopper needs refilling when it is down to one-quarter full.

2. Automatic traction chains may be installed.

UNDERCOATING

1. Entire underside of bus body, including floor sections, crossmembers and below floor line side panels, shall be coated with rust-proofing compound for which compound manufacturer has issued notarized certification of compliance to the bus body builder that compound meets or exceeds all performance and qualitative requirements of paragraph 3.4 of Federal Specifications TT-C-520b using modified test procedures* for following requirements:

a. Salt spray resistance-pass test modified to 5% salt and 1000 hours;

b. Abrasion resistance-pass.

c. Fire resistance-pass,

*Test panels to be prepared in accordance with paragraph 4.6.12 of TT-C-520b with modified procedure requiring that test be made on a 48-hour air cured film at thickness recommended by compound manufacturer.

VENTILATION

1. Auxiliary fans shall meet the following requirements:

   a. Fans for left and right sides shall be placed in a location where they can be adjusted for maximum effectiveness and do not obstruct vision to any mirror.
   Note: All Type A buses may be equipped with one fan.

   b. Fans shall be a nominal 6 inches in diameter.

   c. Fan blades shall be covered with a protective cage. Each fan shall be controlled by a separate switch.

2. Body shall be equipped with a suitably controlled ventilating system of sufficient capacity to maintain proper quantity of air under operating conditions, without having to open windows except in extremely warm weather.

3. Static-type non-closeable exhaust ventilation shall be installed in low-pressure area of roof.

4. Roof hatches designed to provide ventilation, regardless of the exterior weather conditions, may be provided.

WHEELHOUSING

1. Wheelhousing opening shall allow for easy tire removal and service.

2. The wheelhousings shall be attached to floor sheets in such a manner as to prevent any dust, water or fumes from entering the body. Wheelhousings shall be constructed of at least 16-guage steel.

3. The inside height of the wheelhousings above the floor line shall not exceed 12 inches.

4. The wheelhousings shall provide a clearance for installation and use of tire chains on single and dual (if so equipped) power-driving wheels.

5. No part of a raised wheelhousings shall extend into the emergency door opening.

WINDOWS

1. Each side window, other than emergency exits designated to comply with FMVSS 217, shall provide an unobstructed opening of at least 9 inches high but not more than 13 inches high and at least 22 inches wide, obtained by lowering window. One side window on each side of the bus my be less than 22 inches wide.

2. Optional tinted and/or frost-free glazing may be installed in doors, windows, and windshields consistent with federal, state and local regulations.

WINDSHIELD WASHERS

1. A windshield washer system shall be provided.

WINDSHIELD WIPERS

1. A windshield wiping system, two-speed or variable speed, with an intermittent feature, shall be provided.

2. The wipers shall be operated by one or more air or electric motors of sufficient power to operate wipers. If one motor is used, the wipers shall work in tandem to give full sweep of windshield.

WIRING

1. All wiring shall conform to current SAE standards.

2. **Circuits:**

   a. Wiring shall be arranged in circuits, as required, with each circuit protected by a fuse or circuit breaker. A system of color and number coding shall be used and an appropriate identifying diagram shall be provide to the end user along with the wiring diagram provided by the chassis manufacturer. The wiring diagrams shall be specific to the bus model supplied and include any changes to wiring made by the body manufacturer. Chassis wiring diagrams shall also be supplied to the end user. A system of color and number coding shall be used on buses. The following body interconnecting circuits shall be color coded as noted:

FUNCTION	**COLOR**
Left Rear Directional Light	Yellow
Right Rear Directional Light	Dark Green

Stoplights	Red
Back-up lights	Blue
Taillights	Brown
Ground	White
Ignition Feed, Primary Feed	Black

The color of cables shall correspond to SAE J 1128.

b. Wiring shall be arranged in at least six regular circuits as follows:

1) Head, tail, and stop (brake) and instrument panel lamps.

2) Clearance and stepwell lamps (stepwell lamp shall be actuated when service door is opened).

3) Dome lamp.

4) Ignition and emergency door signal.

5) Turn signal lamps.

6) Alternately flashing signal lamps.

c. Any of the above combination circuits may be subdivided into additional independent circuits.

d. Whenever heaters and defrosters are used, at least one additional circuit shall be installed.

e. Whenever possible, all other electrical functions (such as sanders and electric-type windshield wipers) shall be provided with independent and properly protected circuits.

f. Each body circuit shall be coded by number or letter on a diagram of circuits and shall be attached to the body in a readily accessible location.

3. The entire electrical system of the body shall be designed for the same voltage as the chassis on which the body is mounted.

4. All wiring shall have an amperage capacity exceeding the design load by at least 25%. All wiring spliced are to be done at an accessible location and noted as splices on wiring diagram.

5. A body wiring diagram, of a size which can easily read, shall be furnished with each bus body or affixed in an area convenient to the electrical accessory control panel.

6. The body power wire shall be attached to a special terminal on the chassis.

7. All wires passing through metal openings shall be protected by a grommet.

8. Wires not enclosed within body shall be fastened securely at intervals of not more that 18 inches. All joints shall be soldered or joined by equally effective connectors, which shall be water-resistant and corrosion-resistant.

SPECIALLY EQUIPPED SCHOOL BUSES

GENERAL REQUIREMENTS

1. School buses designed for transporting students with special transportation needs shall comply with National Specifications and Procedures and with Federal Motor Vehicle Safety Standards applicable to their GVWR category.

2. Any school bus to be used for the transportation of children who are confined to a wheelchair or other mobile positioning device, or who require life support equipment that prohibits use of the regular service entrance, shall be equipped with a power lift, unless a ramp is needed for unusual circumstances related to passenger needs.

AISLES

1. All school buses equipped with a power lift shall provide a 30 inch aisle leading from any wheelchair/mobility aid position to at least one emergency exit door and the lift area.

COMMUNICATIONS

1. All school buses that are used to transport individuals with disabilities should be equipped with a two-way electronic voice communication system that can be used at any point in the vehicle's route. Where no such service exists, vehicles would be exempt.

GLAZING

1. Tinted glazing may be installed in all doors, windows, and windshields consistent with federal, state, and local regulations.

IDENTIFICATION

1. Buses with power lifts used for transporting individuals with disabilities shall display below the window line at the lift door and rear of the bus the International Symbol of Accessibility. Such emblems shall be white on blue or black background, shall not exceed 12 inches in size, and shall be of a high-intensity reflectorized material meeting U.S. Department of Transportation's Federal Highway Administration. (FHWA) FP-85 Standards.

PASSENGER CAPACITY RATING

1. In determining the passenger capacity of a school bus for purposes other than actual passenger load (i.e., vehicle classification, or various billing/reimbursement models), any

location in a school bus intended for securement of an occupied wheelchair/mobility aid during vehicle operations may be regarded as four designated seating positions. Similarly, each lift area may be regarded as four designated seating positions.

POWER LIFTS and RAMPS

1. Power lift shall be located on the right side of the bus body when not extended. **Exception:** The lift may be located on the left side of the bus if, and only if, the bus is primarily used to deliver students to the left side of a one way street.

2. Ramp device may be used in lieu of a mechanical lift if the ramp meets all the requirements of the Americans with Disability Act (ADA) as founded in **36 CFR § 1192.23** © Vehicle ramp.

3. A ramp device that does not meet the specifications of ADA but does meet the specifications of paragraph three of this section may be installed and used, when, and only when a power lift system is not adequate to load and unload students having special and unique needs. A readily accessible ramp may also be installed for emergency exit use. If stowed in the passenger compartment, the ramp must be properly secured and placed away from general passenger contact. It must not obstruct or restrict any aisle or exit while in its stowed or deployed position.

4. All vehicles covered by this specification shall provide a level-change mechanism or boarding device (e.g., lift or ramp) complying with paragraph b. or c. of this section and sufficient clearances to permit a wheelchair or other mobility aid user to reach a securement location.

   a. Vehicle Lift

      1) **Design loads.** The design load of the lift shall be at least 600 pounds. Working parts, such as cables, pulleys, and shafts, which can be expected to wear, and upon which the lift depends for support of the load, shall have a safety factor of at least 6 (six), based on the ultimate strength of the material. Non working parts, such as platform, frame, and attachment hardware that would not be expected to wear, shall have a safety factor of at least 3 (three), based on the ultimate strength of the material.

      2) **Lift capacity.** The lifting mechanism and platform shall be able to lift a minimum 600 pounds.

   b. Controls

      1) **Requirements:** Controls shall be provided that enable the operator to activate the lift mechanism from either inside or outside the bus. The controls should be interlocked with the vehicle brakes, transmission, or door, or shall provide other appropriate mechanisms or systems to ensure the vehicle cannot be moved when the lift is not stowed and so the lift cannot be deployed unless the interlocks or systems

are engaged. The lift shall deploy to all levels (i.e., ground, curb, and intermediate positions) normally encountered in the operating environment. Where provided, each control for deploying, lowering, raising, and stowing the lift and lowering the roll-off barrier shall be of a momentary contact type requiring continuous manual pressure by the operator and shall not allow improper lift sequencing when the lift platform is occupied. The controls allow reversal of the lift operation sequence, such as raising or lowering a platform that is part way down, without allowing an occupied platform to fold or retract into the stowed position.

2) **Exception:** Where the lift is designed to deploy with its long dimension parallel to the vehicle axis which pivots into or out of the vehicle while occupied (i.e., "rotary lift"), the requirements of this paragraph prohibiting the lift from being stowed while occupied shall not apply if the stowed position is within the passenger compartment and the lift is intended to be stowed while occupied.

c. **Emergency Operation:** The lift shall incorporate an emergency method of deploying, lowering to ground level with a lift occupant, and raising and stowing the empty lift if the power to the lift fails. No emergency method, manual or otherwise, shall be capable of being operated in a manner that could be hazardous to the lift occupant or the operator when operated according to manufacturers' instructions and shall not permit the platform to be stowed or folded when occupied, unless the lift is a rotary lift and is intended to be stowed while occupied. No manual emergency operation shall require more the 2 (two) minutes to lower an occupied wheelchair to ground level.

5. **Power or equipment failure:** Platforms stowed in a vertical position, and deployed platforms occupied, shall have provisions to prevent their deploying, falling, or folding any faster than 12 inches per second or their dropping of an occupant in the event of a single failure or any load carrying component.

6. **Platform barriers:** The lift platform shall be equipped with barriers to prevent any of the wheels or a wheelchair or mobility aid from rolling off the platform during its operation. A movable barrier or inherent design feature shall prevent a wheelchair or mobility aid from rolling off the edge closest to the vehicle until the platform is in its fully raised position. Each side of the lift platform that extends beyond the vehicle in its raised position shall have a barrier a minimum 1 1/2 inches high. Such barriers shall not interfere with maneuvering into or out of the aisle. The loading-edge barrier (outer barrier), which functions as a loading ramp when the lift is at ground level, be sufficient when raised or closed, or a supplementary system shall be provided, to prevent a power wheelchair or mobility aid from riding over or defeating it. The outer barrier of the lift shall automatically raise or close, or a supplementary system shall automatically engage, and remain raised, closed, or engaged at all times that the platform is more the 3 inches above the roadway or sidewalk and the platform is occupied. Alternatively, a barrier or system may be raised, lowered, opened, closed, engaged, or disengaged by the lift operator, provided an interlock or inherent design feature prevents the lift from rising unless the barrier is raised or closed or the supplementary system is engaged.

7. **Platform surface:** The platform surface shall be free of any protrusions over 1/4 inch high and shall be slip resistant. The platform shall have a minimum clear width of 28 1/2 inches at the platform, a minimum clear width of 30 inches measured from 2 inches above the platform surface to 30 inches above the surface of the platform, and a minimum clear length of 48 inches measured from 2 inches above the surface of the platform to 30 inches above the surface of the platform. (See "Wheelchair or Mobility Aid Envelop" figure in Appendix D)

8. **Platform gaps**: Any openings between the platform surface and the raised barrier shall not exceed 5/8 inches in width. When the platform is at vehicle floor height with the inner barrier (if applicable) down or retracted, gaps between the forward lift platform edge and the vehicle floor shall not exceed 1/2 inch horizontally and 5/8 inch vertically. Platforms on semi-automatic lifts may have a hand hold not exceeding 1 1/2 inch by 4 1/2 inch located between the edge barriers.

9. **Platform entrance ramp:** The outboard entrance ramp or loading-edge barrier used as a ramp and the transition plate from the inboard edge of the platform to the vehicle floor shall not exceed a slope of 1:8, measured on level ground, for a maximum rise of 3 inches, and the transition from roadway or sidewalk to ramp may be vertical without edge treatment up to 1/4 inch. Thresholds between 1/3 inch and 1/2 inch shall be beveled with a slope no greater than 1:2.

10. **Platform deflection:** The lift platform (not including the entrance ramp) shall not deflect more than 3 degrees (exclusive of vehicle roll or pitch) in any direction between its unloaded position and its position when loaded with 600 pounds applied through a 26 inch by 26 inch test pallet at the centroid of the platform.

11. **Platform movement:** No part of the platform shall move at a rate exceeding 6 inches per second during lowering and lifting on occupant, and shall not exceed 12 inches per second during deploying or stowing. This requirement does not apply to the deployment or stowage cycles of lifts that are manually deployed or stowed. The maximum platform horizontal and vertical acceleration when occupied shall be 0.3 g.

12. **Boarding direction:** The lift shall permit both inboard and outboard facing of wheelchair and mobility aid users.

13. **Use by standees:** Lifts shall accommodate persons using walkers, crutches, canes or braces, or who otherwise have difficulty using steps. The platform may be marked to indicate a preferred standing position.

14. **Handrails:** Platforms on lifts shall be equipped with handrails on two sides, which move in tandem with the lift, and which shall be graspable and provide support to standees throughout the entire lift operation. Handrails shall have a usable component at least 8 inches long with the lowest portion a minimum 30 inches above the platform and the highest portion a maximum 38 inches above the platform. The handrails shall be capable of withstanding a force of 100 pounds concentrated at any point on the handrail without permanent deformation of the rail or its supporting structure. The handrail shall have a cross-sectional

diameter between 1 1/4 inches and 1 1/2 inch or shall provide an equivalent grasping surface, and have eased edges with corner radii of not less that 1/8 inch. Handrails shall be placed to provide a minimum 1 1/2 inch knuckle clearance from the nearest adjacent surface. Handrails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

15. **Circuit breaker:** A resettable circuit breaker shall be installed between power source and lift motor if electrical power is used. It shall be located as close to the power source as possible, but not within the passenger/driver compartment.

16. **Excessive pressure:** Lift design shall prevent excessive pressure that could damage the lift system when the platform is fully lowered or raised, or that could jack the vehicle.

17. **Documentation:** The following information shall be provided with each vehicle equipped with a lift:

    1) A phone number where information can be obtained about installation, repair, and parts. (Detailed written instructions and a part's list shall be available upon request.)

    2) Detailed instructions regarding use of the lift and readily visible when the lift door is open, including a diagram showing the proper placement and positioning of wheelchair/mobility aids on lift.

18. **Training materials:** The lift manufacturer shall make available training materials to ensure the proper use and maintenance of the lift. These may include instructional videos, classroom curriculum, system test results, or other related materials.

19. **Identification and certification:** Each lift shall be permanently and legibly marked or incorporate a non-removable label or tag that states that it conforms to all applicable requirements of the current National Specifications and Procedures for School Buses. In addition, the lift manufacturer, or an authorized representative, upon request of the original titled purchaser, shall provide a notarized Certificate of Conformance, either original or photocopied, which states that the lift system meets all the applicable requirements of the current National Specifications and Procedures for School Buses.

20. **Vehicle ramp:**

    1) If a ramp is used, it shall be of sufficient strength and rigidity to support the special device, occupant, and attendant(s). It shall be equipped with a protective flange on each longitudinal side to keep special device on the ramp.

    2) Floor of ramp shall be constructed of non-skid material.

    3) Ramp shall be equipped with handles and be of weight and design to permit one person to put ramp in place and return it to its storage place.

4) Ramps installed in raised floor buses by manufacturers may be used for emergency evacuation purposes. They shall not be used as a substitute for a lift when a lift is capable of servicing the need.

REGULAR SERVICE ENTRANCE

1. A suitable device shall be provided to assist passengers during entry or egress. This device shall allow for easy grasping or holding and shall have no openings or pinch points that might entangle clothing, accessories or limbs.

RESTRAINING DEVICES

1. On power-lift equipped vehicles, seat frames may be equipped with attachments or devices to which belts, restraining harnesses or other devices may be attached. Attachment framework or anchorage devices, if installed, shall conform to FMVSS 210.

2. Seat belt assemblies, if installed, shall conform to FMVSS 209.

3. Child restraint systems, which are used to facilitate the transportation of children who in other modes of transportation would be required to use a child, infant, or booster seat, shall conform to FMVSS 213 and 222.

SEATING ARRANGEMENTS

1. Flexibility in seat spacing to accommodate special devices shall be permitted to meet passenger requirements. All seating shall be forward-facing.

SECUREMENT and RESTRAINT SYSTEM FOR WHEELCHAIR/MOBILITY AID and OCCUPANT

For the purposes of better understanding the various aspects and components of this section, the term **securement** or phrase **securement system** is used exclusively in reference to the device(s) which secure the wheelchair/mobility aid. The term **restraint** or phrase **restraint system** is used exclusively in reference to the device(s) used to restrain the occupant of the wheelchair/mobility aid. The phrase **securement and restraint system** is used to refer to the total system that secures and restrains both the wheelchair/mobility aid and the occupant.

1. **Securement and restraint system-general**

   a. The Wheelchair/Mobility Aid Securement and Occupant Restraint System shall be designed, installed, and operated to accommodate passengers in a forward-facing orientation within the bus and shall comply with all applicable requirements of FMVSS 222. Gurney-type devices shall be secured parallel to the side of each bus.

b. The securement and restraint system, including the system track, floor plates, pockets, or other anchorages should be provided by the same manufacturer, or should be certified to be compatible by manufacturers of all equipment/systems used.

c. When a wheelchair/mobility aid securement device and an occupant restraint share a common anchorage, including occupant restraint designs that attach the occupant restraint to the securement device or the wheelchair/mobility aid, the anchorage shall be capable of withstanding the loads of both the securement device and occupant restraint applied simultaneously, in accordance with FMVSS 222. (see §2 and §3 of this section)

d. When a wheelchair/mobility aid securement device (webbing or strap assembly) is shared with an occupant restraint, the wheelchair/mobility aid securement device (webbing or strap assembly) shall be capable of withstanding a force twice the amount as specified in §4.4 (a) of FMBSS 209. (See §2 and §3 of this section)

e. The bus body floor and sidewall structures where the securement and restraint system anchorages are attached shall have equal or greater strength than the load requirements of the system(s) being installed.

f. The occupant restraint system shall be designed to be attached to the bus body either directly or in combination with the wheelchair/mobility aid securement system, by a method which prohibits the transfer of weight or force from the wheelchair/mobility aid securement system, by a method which prohibits the transfer of weight or force from the wheelchair/mobility aid to the occupant in the event of an impact.

g. The securement and restraint system may incorporate an identification scheme that will allow for the easy identification of the various components and their functions. It may consist of one of the following, or combination thereof:

    1) The wheelchair/mobility aid securement device (webbing or strap assemblies) and the occupants' restraint belt assemblies may be of contrasting color or color shade.

    2) The wheelchair/mobility aid securement device (webbing or strap assemblies) and occupant restraint belt assemblies may be clearly marked to indicate the proper wheelchair orientation in the vehicle, and the name and location for each device or belt assembly, i.e., front, rear, lap belt, shoulder belt, etc.

    3) Diagramed instruction sheet on wheelchair/mobility aid securement.

h. All attachment or coupling devices designed to be connected or disconnected frequently shall be accessible and operable without the use of tools or other mechanical assistance.

i. All securement and restraint system hardware and components shall be free of sharp or jagged areas and shall be of a non-corrosive material or treated to resist corrosion in accordance with §4.3 (a) of FMVSS 209.

j. A device for storage of the securement and restraint system shall be provided.

k. The entire securement and restraint system, including the storage device, shall meet the flammability standards established in FMVSS 302.

l. Each securement device (webbing or strap assembly) and restraint belt assembly should be permanently and legibly marked or incorporate a non-removable label or tag that states that it conforms to all applicable FMVSS requirements, as well as, the current National Specifications and Procedures for School Buses.

m. The following information shall be provided with each vehicle equipped with a securement and restraint system:

   1) A phone number where information can be obtained about installation, repair, and parts. (Detailed written instructions and a part's list shall be available upon request).

   2) Detailed instructions regarding use, including a diagram showing the proper placement of the wheelchair/mobility aids and positioning of securement devices and occupant restraints, including correct belt angles.

n. The system manufacturer shall make available training materials to ensure the proper use and maintenance of the wheelchair/mobility aid securement and occupants' restraint system. These may include instructional videos, classroom curriculum, system test results, or other related materials.

2. **Wheelchair/mobility aid securement system**

a. Each securement system location shall consist of a minimum of four anchorage points. A minimum of two anchorage points shall be located in front of the wheelchair/mobility aid and a minimum of two anchorage points shall be located in the rear. The securement anchorages shall not interfere with passenger movement or present any hazardous condition.

b. Each securement system location should have a minimum clear floor area of 30 inches by 48 inches. Additional floor area may be required for some applications. Consultation between the user and the manufacturer is recommended to ensure adequate area is provided.

c. The securement system shall secure common wheelchair/mobility aids and shall be able to be attached easily by a person having average dexterity and who is familiar with the system and wheelchair/mobility aid.

d. As installed, each securement anchorage shall be capable of withstanding a minimum force of 3,000 pounds (13,244 Newtons) when applied as specified in FMVSS 222. When more than one securement device share a common anchorage, the anchorage shall

be capable of withstanding the force indicated above, multiplied by the number of securement devices sharing that anchorage.

e. Each securement device, if incorporating webbing or a strap assembly, shall comply with the requirements for Type I safety belt systems, in accordance with §4.2, §4.3, and §4.4 (a) of FMVSS 209.

f. The securement system shall secure the wheelchair/mobility aid in such a manner that the attachments or coupling hardware will not become detached when any wheelchair/mobility aid component deforms, when one or more tires deflate, and without international operation of a release mechanism (e.g., a spring clip on a securement hook).

g. Each securement device (webbing or strap assembly) shall be capable of withstanding a minimum force of 2,500 pounds when tested in accordance with FMVSS 209.

h. Each securement device (webbing or strap assembly) shall provide a means of adjustment, or manufacturers' design, to remove slack from the device or assembly.

3. **Occupant restraint system**

a. A Type 2A occupant restraint system that meets all applicable requirements of FMVSSs 209 and 210 shall provide for restraint of the occupant.

b. The occupants' restraint system shall be made of materials that do not stain, soil, or tear an occupant's clothing, which are resistant to water damage and fraying.

c. Each restraint system location shall have not less than on anchorage, of manufacturers' design, for the upper end of the upper torso restraint.

1) The anchorage for each occupant's upper torso restraint shall be capable of withstanding a minimum force of 1,500 pounds (6,672 Newtons) when applied as specified in FMVSS 222.

d. Each wheelchair/mobility aid location shall have not less than two floor anchorages for the occupant pelvic and the connected upper torso restraint.

1) Each floor anchorage shall be capable of withstanding a minimum force of 3,000 pounds (13,344 Newtons) when applied as specified in FMVSS 222.

2) When more that one occupant restraint share a common anchorage, the anchorage shall be capable of withstanding a minimum force of 3,000 pounds (13,344 Newtons) multiplied by the number of occupant restraints sharing the common anchorage in accordance with FMVSS 222.

e. Each floor and wall anchorage which secures the occupants restraint to the vehicle which is not permanently attached, shall be of a "positive latch" design, and shall not allow for any accidental disconnection.

4. **Dynamic Testing**

a. A Type 2A occupant restraint system that meets all applicable requirements of FMVSS's 209 and 210 shall provide for restraint of the occupant.

b. The occupants' restraint system shall be made of materials that do not stain, soil, or tear an occupant's clothing, which are resistant to water damage and fraying.

c. Each restraint system location shall have not less than one anchorage, of manufacturers' design, for the upper end of the upper torso restraint.

1) The anchorage for each occupant's upper torso restraint shall be capable of withstanding a minimum force of 1,500 pounds (6,672 Newtons) when applied as specified in FMVSS 222.

d. Each wheelchair/mobility aid location shall have not less than two floor anchorages for the occupant pelvic and the connected upper torso restraint.

1) Each floor anchorage shall be capable of withstanding a minimum force of 3,000 pounds (13,344 Newtons) when applied as specified in FMVSS 222.

2) When more than one occupant restraint share a common anchorage, the anchorage shall be capable of withstanding a minimum force of 3,000 pounds (13,344 Newtons) multiplied by the number of occupant restraints sharing the common anchorage in accordance with FMVSS 222.

e. Each floor and wall anchorage which secures the occupants restraint to the vehicle which is not permanently attached, shall be of a "positive latch" design, and shall not allow for any accidental disconnection.

5. **Dynamic testing**

a. The wheelchair/mobility aid securement and occupants' restraint system shall be subjected to, and successfully pass, a dynamic sled test at a minimum impact speed/deceleration of 30 mph/20g's.

b. The dynamic test shall be performed by experienced personnel using an impact simulator with proven ability to provide reliable, accurate, and test results that can be replicated.

c. The dynamic test shall be performed in accordance with the procedures set forth in Appendix A of SAE J2249 "Test for Frontal Impact Crash Worthiness."

d. The wheelchair/mobility aid used for testing purposes shall be a rigid, reusable surrogate wheelchair that complies with the requirements of Appendix D of SAE J2249 "Specifications for Surrogate Wheelchair."

e. The dynamic test shall be performed using system assemblies, components and attaching hardware that are identical to the final installation in type, configuration and positioning. The body structure of the anchorage points may be simulated for the purpose of the sled test.

f. When tested, the wheelchair/mobility aid securement and occupants' restraint system shall pass the criteria specified in Section 6.2 of SAE J2249 "Performance Requirements of Frontal Sled Impact Test." Following is an abridges summary of the criteria. (See Appendix D).

   1) Retain the test dummy in the test wheelchair and on the test sled with the test wheelchair in an upright position.

   2) Not show any fragmentation or complete separation of any load carrying part.

   3) Not allow the horizontal excursions of the test dummy and the test wheelchair to exceed specified limits.

   4) Prevent the test wheelchair from imposing forward loads on the test dummy.

   5) Allow removal of the test dummy and the test wheelchair, subsequent to the test, without the use of tools.

SPECIAL LIGHT

1. Doorways in which lifts are installed, shall have, when lift is to be used, at least 2 foot-candles of illumination measured on the floor of the bus immediately adjacent to the lift, and on the lift, when deployed at the vehicle floor level.

SPECIAL SERVICE ENTRANCE

1. Power lift-equipped bodies shall have a special service entrance to accommodate the power lift.

   Exception: If the lift is designed to operate within the regular service entrance, and is capable of stowing such that the regular service entrance is not blocked in any way, and that person entering or exiting the bus is not impeded in any way, a special service entrance shall not be required.

2. The special service entrance and door shall be located on the right side of the bus and shall be designed so as not to obstruct the regular service entrance.

Exception: A special service entrance and door may be located on the left side of the bus if, and only if, the bus is used primarily to deliver students to the left side of one way streets and its use is limited to the function.

3. The opening may extend below the floor through the bottom of the body skirt. If such an opening is used, reinforcements shall be installed at the front and rear of the floor opening to support the floor and give the same strength as other floor openings.

4. A drip molding shall be installed above the opening to effectively divert water from entrance.

5. Door posts and headers from entrance shall be reinforced sufficiently to provide support and strength equivalent to the areas of the side of the bus not used for special service entrance.

SPECIAL SERVICE ENTRANCE DOORS

1. A single door or double doors may be used for the special service entrance.

2. A single door may be hinged to the forward side of the entrance unless doing so would obstruct the regular service entrance. If, due to the above condition, the door is hinged to the rearward side of the doorway, the door shall utilize a safety mechanism which will prevent the door from swinging open should the primary door latch fail. If double doors are used the system shall be designed to prevent the door(s) from being blown open by the wind resistance created by the forward motion of the bus, and/or incorporate a safety mechanism to provide secondary protection should the primary latching mechanism(s) fail.

3. All doors shall have positive fastening devices to hold doors in the open position.

4. All doors shall be weather sealed.

5. When manually-operated dual doors are provided, the rear door shall have at least a one-point fastening device to the header. The forward-mounted door shall have at least three-point fastening devices. One shall be to the header, one to the floor line of the body, and the other shall be into the rear door. The door and hinge mechanism shall be of a strength that is greater than or equivalent to the emergency exit door.

6. Door materials, panels and structural strength shall be equivalent to the conventional service and emergency doors. Color, rub rail, extensions, lettering and other exterior features shall match adjacent sections of the body.

7. Each door shall have windows set in rubber that are visually similar in size and location to adjacent non-door window. Glazing shall be of same type and tinting (if applicable) as standard fixed glass in other body locations.

8. Door(s) shall be equipped with a device that will actuate an audible or flashing signal located in the driver's compartment when door(s) is not securely closed and ignition is in "on" position.

9. A switch shall be installed so that the lifting mechanism will not operate when the lift platform door(s) is closed.

10. Special service entrance doors shall be equipped with padding at the top edge of the door opening. Padding shall be at least 3 inches wide and 1 inch thick and extend the full width of the door opening.

SUPPORT EQUIPMENT and ACCESSORIES

1. Each bus that is set up to accommodate wheelchair/mobility aids or other assertive or restraint devices that utilize belts, shall contain at least one belt cutter properly secured in a location within reach of the driver while belted into his/her driver's seat. The belt cutter shall be durable and designed to eliminate the possibility of the operator or others being cut during use.

2. Special equipment or supplies which are used on the bus for mobility assistance, health support, or safety purposes shall meet any local, federal, or engineering standards that my apply, including proper identification.

    a. Wheelchairs and other mobile seating devices. (See section on Securement System for Mobile Seating Devices/Occupant)

    b. Crutches, walkers, canes, and other ambulating devices.

    c. Medical support equipment. This may include respiratory devices such as oxygen bottles or ventilators. Tanks and valves should be located and positioned to protect them from direct sunlight, bus heater vents, or other heat sources. Other equipment may include intravenous, and fluid drainage apparatus.

TECHNOLOGY AND EQUIPMENT, NEW

It is the intent of these specifications to accommodate new technologies and equipment that will better facilitate the transportation of students. When the new technology, piece of equipment, or component is desired to be applied to the school bus, and it meets the following criteria, it may be acceptable.

1. If (the technology, equipment or component) shall not compromise the effectiveness or integrity of any major safety system, unless it completely replaces the system. (Examples of safety systems include, but are not limited to, compartmentalization, the eight light warning system, emergency exit opportunity, and the uncluttered yellow color scheme.)

2. It shall not diminish the safe environment of the interior of the bus.

3. It shall not create additional risk to students who are boarding or exiting the bus or are in or near the school bus loading zone.

4. It shall not create undue additional activity and/or responsibility for the driver.

5. It shall generally increase efficiency and/or safety of the bus, or generally provide for a safer or more pleasant experience for the occupants and pedestrians in the vicinity of the bus, or generally assist the driver or make his/her many tasks easier to perform.

ALTERNATIVE FUELS

INTRODUCTION

This standard is designed to be used as an overview of the alternative fuels being utilized for school transportation. The standard is not designed to replace current applicable federal, state, manufacturing or safety standards that may exceed requirements within this standard. There will be advancements in engineering and improvements in equipment fabrication methods and operation practices that differ from those specifically called for in this standard. Such deviations or improvements may provide safety and may meet the intent of and be compatible with this standard. Entities wishing to purchase alternative fuel school buses should use this section only as a starting point. More detailed specifications, including specific design and performance criteria and safety standards, should be researched by prospective purchasers of alternative fuel school buses.

GENERAL REQUIREMENTS

Alternative fuel school buses shall meet the following requirements:

1. Chassis shall meet all standards previously mentioned in BUS CHASSIS STANDARDS.

2. Chassis shall meet all applicable FMVSS standards.

3. Fuel system integrity shall meet the specified leakage performance standards when impacted by a moving contoured barrier in accordance with test conditions specified in FMVSS 301 or FMVSS 303, as applicable.

4. Original equipment manufacturers (OEMs) and conversion systems using compressed natural gas (CNG) shall comply with NFPS Standard 52 A Compressed Natural Gas Vehicular Fuel Systems@ in effect at the time of installation. Fuel systems using liquefied petroleum gas (LPG) shall comply with the NFPA Standard 58 A Liquefied Petroleum Gases Engine Fuel Systems@ in effect at the time of installation.

5. All alternative fuel buses shall have a loaded range of not less than 200 miles, except those powered by electricity which shall have a leaded range of not less than 80 miles.

6. Natural gas-powered buses shall be equipped with an interior/exterior gas detection system. All natural gas-powered buses shall be equipped with an automatic or manual fire detection and suppression system.

7. All materials and assemblies used to transfer or store alternative fuels shall be installed outside the passenger/driver compartment.

8. All Types C and D buses using alternative fuel shall meet the same base requirements of BUS CHASSIS STANDARDS for Power and Grade ability, i.e., at least one published net horsepower per each 185 pounds of GVWR.

9. The total weight shall not exceed the GVWR when loaded to rated capacity.

10. The manufacturer supplying the alternative fuel equipment must provide the owner and operator with adequate training and certification in fueling procedures, scheduled maintenance, troubleshooting, and repair of alternative fuel equipment.

11. All fueling equipment shall be designed specifically for fueling motor vehicles and shall be certified by the manufacturer as meeting all applicable federal, state and industry standards.

12. All on-board fuel supply containers shall meet all appropriate requirements of the ASME code, the DOT regulations, or applicable FMVSS and NFPA Standards.

13. All fuel supply containers shall be securely mounted to withstand a static force of 8 times their weight in any direction.

14. All safety devices that may discharge to the atmosphere shall be vented to the outside of the vehicle. The discharge line from the safety relief valve on all school buses shall be located in a manner appropriate to the characteristics of the alternative fuel. Discharge lines shall not pass through the passenger compartment.

15. A positive quick acting (1/4 turn) shut-off control valve shall be installed in the gaseous fuel supply lines as close to the fuel supply containers as possible. The controls for this valve shall be placed in a location easily operable from the exterior of the vehicle. The location of the valve control shall be clearly marked on the exterior surface of the bus.

16. A grounding system shall be required for grounding of the fuel system during maintenance related venting.

APPENDIX A
Terms & Definitions

Access Panel: A body panel which must be moved or removed to provide access to one or more serviceable components.

Accessibility: Ability of vehicles and facilities to accommodate people with disabilities.

Activity Trip: The transportation of students to any event sanctioned for pupil attendance or authorized by officer, employee or agent of a public or private school, other than to-and-from school transportation. See also field trip.

ADA: The Americans with disabilities Act, PL 10 1-336, 42 USC 12101, et seq.

Adaptive device: Any item or piece of equipment used to increase, maintain, or improve functional capabilities of children with disabilities. Also known as assistive technology device.

Alternately flashing signal lamps: A system of red or red and amber signal lights mounted horizontally both front and rear, intended to identify a vehicle as a school bus and to inform other users of the highway that the bus is about to stop or is stopped to load or unload children. Also known as SOS lights, school bus traffic warning lights.

Alternative fuel Vehicle: A vehicle designed to operate on an energy source other than gasoline or regular grades of diesel. Such fuels include, but are not limited to, CNG, LNG, LPG, advanced diesel fuel formulations, and electricity.

> **Bi-fuel:** A vehicle designed to operate on two different fuels, but not simultaneously.
>
> **Dual Fuel:** A vehicle designed to operate on a mixture of two different fuels.
>
> **Hybrid power:** The use of two or more power sources to provide the motive force for the vehicle, e.g. electricity to drive the wheels with internal combustion to supplement the battery.

Anchorage point: The point of attachment of a securement system or occupant restraint to the vehicle structure.

ANPR: Advanced Notice of Proposed Rule making. Notice published in the Federal Register by a federal agency such as NHTSA requesting information and inviting comment on a proposed change of regulation.

ANSI: American National Standards Institute, the organization which administers and coordinates the development of voluntary industry standards.

Antilock brakes: Brake systems with sensors that automatically control the degree of wheel slip during braking and relieve brake pressure on wheels that are about to lock up.

Aspect ratio: Percentage used to express the ratio of a tire's height **to** its width. Also known as tire Profile.

Assessment team: A group of persons, including the parent or guardian of a student with disabilities, who develop a profile of the student in terms of his or her mental and physical functioning in order to determine the student's eligibility for special education. See also MDC.

BAT: Breath Alcohol Technician. An individual who instructs and assists person in the alcohol testing process and operates and EBT

Bio-diesel: Vehicle fuel made from plant matter and commonly mixed with diesel in engines.

Body fluids cleanup kit: Package of materials including but not limited to latex gloves, disposal bog, and absorbent material, used to clean up spills of potentially infected bodily fluids, under OSHA's Blood Borne Pathogens regulations and Universal Precautions practices. Also known as hygiene kit.

Brake: A device or mechanism used to retard and stop the speed of a moving vehicle or to prevent the movement of a stopped vehicle.

> **Emergency brake:** A mechanism designed to stop a motor vehicle after a failure of the service brake system.
>
> **Retarder:** An auxiliary braking device used to reduce brake wear.
>
> **Service brake:** The primary mechanism designed to retard and stop a moving vehicle.
>
> **Parking brake:** A mechanism designed to prevent the movement of a stationary motor vehicle.
>
> **Brake fade:** A condition that occurs as brakes become less effective.

Bus: A motor vehicle with motive power, except a trailer, designed for carrying more than 10 persons.

> **Activity bus:** A bus owned, leased, or contracted by a school district and regularly used to transport students on field trips, athletic trips, or other curricular **or** extracurricular activities, but not used for to-and-from school transportation. Must meet all FMVSS for school buses.
>
> **Charter bus:** A bus that is operated under a short-term contract with a school district or other sponsor who has acquired the exclusive use of the vehicle at a fixed charge to transport students to a school-related event.

DOT bus: A school bus that meets the FMCSR standards for interstate transportation set forth in 49 CFR 390.

Intercity bus: A large bus with front doors only, high-back seats and under-floor luggage storage for high-speed, long distance trips. Also known at motor coach and over-the-road coach.

Nonconforming bus: Any vehicle designed to carry more than ten passengers that is used to transport children to or from school or school-related activities which does not meet the federal standards to school buses.

School bus: A bus owned, leased, contracted or operated by a school or school district and regularly used to transport students to and from school or school-related activities, but not include

Type A: A Type "A" school bus is a van conversion or bus constructed utilizing cutaway front-section vehicle with a left side driver's door. The entrance door is behind the front wheels. This definition includes two classifications: Type A1, with a Gross Vehicle Weight Rating (GVWR) less than or equal to 10,000 pounds and Type A2, with a GVWR of greater than 10,000 pounds.

Type B: A Type B school bus is constructed utilizing a stripped chassis. The entrance door is behind the front wheels. This definition eludes two classifications: Type B1, with a GVWR less than or equal to 10,000 pounds, and Type B2 with a GVWR greater than 10,000 pounds.

Type C: A Type C school bus is constructed utilizing a chassis with a hood and front fender assembly. The entrance door is behind the front wheels.

Type D: A type D school bus is **constructed utilizing a stripped chassis**. The entrance door is ahead of the front wheels.

Specially equipped: A school bus designed, equipped, or modified to accommodate students with special needs.

Transit bus: A bus designed for frequent stops, with front and back-center doors and low-back seating operated on a fixed schedule and route to provide public transportation by indiscriminately taking on passengers.

Bus body: The portion of a bus that encloses the bus occupant space exclusive of the bumpers, the chassis frame, and any structure forward of the forward most point of the windshield mounting.

Bus yard: An area for storage and maintenance of buses.

CAA: Clean Air Act. Also known as CAAA, the Clear Air Act Amendments of 1990.

Capacity: See seating capacity.

Capitol costs: Long-term costs associated with the purchase of vehicles, buildings, and property.

Captive: Refers to a non-removable attachment, part, or fitting on a securement system.

Carrier: Any public school district, any public or private educational institution providing preschool elementary or secondary education, or any person, firm or corporation under contract to such a district or institution, engaged in transporting students.

Casualty Insurance: See liability insurance.

CDIP: Commercial Drivers Instructional Permit. The learners permit that a CDL applicant receives when he/she passes the knowledge tests; it allows the applicant to driver a CMV when accompanied by a CDL driver.

CDL: Commercial Drivers License.

CFR: Code of Federal Regulations.

Chassis: Vehicle frame with all operating parts including engine frame, transmission, wheels and brakes.

Chassis starting interlock circuit: A device which prevents the engine of a bus from starting if any of the emergency exits are locked.

CSRS: Child Safety Restraint System. A device meeting the requirements of FMBSS 213, designed for use in a motor vehicle to restrain, seat or position a child who weights less than 50 pounds (child safety seat, car seat).

CMV: Commercial Motor Vehicle A motor vehicle defined in 49CFR 390.5, having a GVWR of 10,001 pounds or designed to transport 16 or more passengers, including the driver, or used to transport hazardous material.

CMVA: Commercial Motor Vehicle Safety Act of 1986; among other things, authorization for DCL.

CNG: Compressed natural gas.

Common carrier: A public bus, train, or airplane that travels on a prescribed route and schedule, and accepts passengers indiscriminately.

Communicable disease: Any illness that can be transmitted from one person to another, including most common childhood diseases, the common cold, and serious illness such as hepatitis and AIDS.

Community transportation: Services that address all transit needs of a community, including general and special populations, such as the elderly and disabled.

Companion animal: An animal trained to provide assistance for persons with disabilities; can be a guide animal, assistive animal, or service animal.

Completed vehicle: A vehicle the requires no further manufacturing operation to perform its intended function, other than the addition of readily attachable components, such as mirrors or tire and rim assemblies, or minor finishing operations such as painting.

Conduct report: Form authorized by school official for the use by drivers to report instances of unacceptable behavior by school bus passengers. Also known as discipline report.

Continuum of services: The range of possible options, from least restrictive to most restrictive, available to students with disabilities for transportation services.

Crash, School bus: (1) A motor vehicle crash involving a school bus with or without pupil on board, resulting in any personal injury or death, or disabling damage to one or more motor vehicles requiring the vehicle(s) to be transported away from the scene by a two truck or other vehicle, or **(2)** A collision involving any vehicle or any pupil or school bus at any time during the loading or unloading process.

> **Preventable:** A crash that could have been prevented by reasonable action on the part of the school bus driver.
>
> **Reportable:** A crash required to be reported under FMCSR, i.e. a crash involving a CMV on a public road in which there is a fatality or an injury treated away from the scene, or that requires a vehicle to be towed from the scene.

Crash test: See impact test.

Criminal record check: The investigation of a person's criminal history through submission of fingerprints to state and/or federal authorities. Also known as background check.

Crossing arm: Device attached to the front bumper of a school bus, activated during loading and unloading, designed to force the students to walk far enough away from the front of the bus to be seen by the driver. Also known as crossing control arm.

Curb cut: Area where the street curb has been cut and sloped to allow the sidewalk to lead smoothly to the roadway.

Curb weight: The weight of a motor vehicle with standard equipment, maximum capacity of engine fuel, oil, and coolant, and, if applicable, air conditioning and additional weight of optional engine, but without passengers.

Danger zone A ten foot area immediately surrounding the stopped school bus.

Deadhead: Movement of bus without passengers, e.g. from school to bus yard.

Deadtime: The period between arriving at any activity trip destination and leaving the destination for the trip home. Also known as waiting time and standby time.

Dealer: Any person who is engaged in the sale and distribution of new motor vehicles or motor vehicle equipment primarily to purchases who, in good faith, purchase any such vehicle or equipment for purposes other than resale.

Distributor: Any person who is engaged in the sale and distribution of motor vehicles or motor vehicle equipment for resale

Dispatch: To relay service instructions to drivers.

DOT: United States Department of Transportation.

Downtime: Period when a vehicle in inoperative, e.g. due to mechanical failure.

Dual brake system: See split brake system.

Dual fuel system: See alternative fuel.

DVIR: Driver vehicle inspection report. Federal, state, or local approved form for reporting results of pre-trip and post-trip inspections. Also known as daily vehicle inspection report and pre-trip inspection reports.

Dynamic testing: The process of subjecting vehicle, mobility aid, or mobility aid/securement system components to a simulated crash condition at a minimum impact speed/deceleration of 30 mph/20G's.

EHA: The Education for all Handicapped Children Act, passed in 1075 as P.L. 94-142, See IDEA. ERA The Education for all Handicapped Children

Emergency roof exit: An opening in the roof of the bus meeting the requirements of FMVSS 217 which provides emergency egress and sometimes ventilation . Also known as roof batch.

Emergency response plan: A detailed approach to identifying and responding to potential accidents involving hazardous substances, required for every community by the Emergency Planning and Right-to-Know Act of 1986.

EPA: The United State Environmental Protection Agency.

Early bus: A bus schedules to run prior to the regular morning run, e.g. to take children to day care programs located in schools.

Early intervention service: Education and related services provided to infants and toddlers from birth through two years of age.

Effective date: The date at which a regulation or standard takes effect, on or after which compliance is legally required.

Ergonomics: The study of the design of equipment to reduce human fatigue and discomfort.

Ethanol: Grain alcohol, distilled from fermented organic matter and used as a vehicle duel.

Extended year service: Transportation provided for students subsequent to the end of the traditional school year.

FAPE: Free Appropriate Public Education, Guaranteed by the EHA for a handicapped children, it includes special education and related service, including transportation.

FERPA: The Family Educational Rights and Privacy Act of 1974, 20 USC 1232. Requires confidentiality of student records in public schools, but allows access to necessary information regarding student disabilities and/or health needs to those who have a need to know, including school bus drivers.

FHWA: Federal Highway Administration. An agency of the U.S. DOT.

Federal Motor Carrier Safety Administration: An agency of the U.S. DOT, formerly the Office of Motor Carrier Highway Safety, part of the Federal Highway Administration.

FMCSR: Federal Motor Carrier Safety Regulations, 49 CFT 383, 390-397, and 399. Motor vehicle safety and construction standards under FHWA that apply to commercial motor vehicles and drivers transporting passengers in interstate commerce.

FMVSS: Federal Motor Vehicle Safety Standards, 49 CFT 571. Construction standards under NHTSA that apply generally to all new motor vehicles and motor vehicle equipment.

Final stage manufacturer: A person who performs such manufacturing operations on an incomplete vehicle that it becomes a completed vehicle.

Forward control bus: A school bus in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length. Also known as transit-style.

Forward-facing: Installation of the securement system in such a way that the mobile seating device and its occupant face the front of the vehicle when secured.

Four point tiedown: A securement system in which four strap assemblies attach to the wheelchair frame at four separate points, and anchor to the vehicle floor at four separate points.

FSS: Fire suppressant system. A fire extinguisher system installed in the engine compartment of a vehicle.

FTA: Federal Transit Administration, part of U.S. DOT. Formerly UMTA.

Fuel Injection: System that uses no carburetor but sprays fuel directly into the cylinders or into intake manifold.

Glazing: The glass or glass-like portion of a window.

> **Laminated glass:** Any glazing material that consists of one or more sheets of glass and an inboard-facing surface sheet of plastic, the components being held together by intervening plies of plastic interlayer or by the self-bonding characteristic of the inboard plastic layer.
>
> **Safety glass:** Glazing material constructed, treated, or combined with other material so as to reduce, in comparison with ordinary glass, the likelihood of injury to persons as a result of contact with the glass, either broken or unbroken,
>
> **Storm Window:** Two or more sheets of safety glazing material separated by an airspace to provide insulting properties and fixed in a common frame or mounting.
>
> **Tempered glass:** Glazing which consists of glass that has been tempered to meet the properties of safety glass.

GAWR: Gross axle weight rating. The value specified by the manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

Guideline 17: A highway safety program guide for pupil transportation safety issued by NHTSA in 23 CFT 1204. Formerly Standard 17.

GVWR: Gross axle weight rating. The value specified by the manufacturer as the load weight, with passengers, of a single vehicle.

Handrail inspection tool: A device, formed by tying a half inch hex nut to a 36 inch cord, used to inspect school bus handrails and other areas for possible snagging hazards.

Hazard lights: Lamps that flash simultaneously to the front and rear on the right and left sides of a vehicle, used to indicate caution. Also known as four-way flashers.

Head protection zone: The empty space above and in front of each school bus passenger seat which is not occupied by side wall, window, or door structure, the dimensions of which are detailed in FMVSS 222.

Head Start: Program initiated in 1965 to provide comprehensive child development services to preschool children of predominately low income families.

Heading: Sign above the windshield of the bus, which can be changed from School Bus to other working such as charter.

Highway: Any public highway, road, street, alley, parkway, or other place open to public motor vehicle travel.

Horsepower: The measurement of an engine's ability to do work. One horsepower is the ability to lift 33,000 lbs. On foot in one minute.

HOV: High Occupancy Vehicle: A vehicle that can carry two or more passengers.

House of service: Legal hours a driver may drive as defined under FMVSS 395.

ICC: The former Interstate Commerce Commission the economic regulation agency within the Department of Transportation. The agency was disbanded in 1997 as a result of economic deregulation, and most functions transferred to the Federal.

IDEA: The Individuals with Disabilities Education Act, passed in 1990 as P.L. 101-476 (Part B) to replace the EHA.

IEP: Individualized Education Program. A plan including information for each child with disabilities required under P.L. 10 1-476 (Part B)

IFSP: Individualized Family Service Plan: a written plan similar to the IEP for the family of a child receiving early intervention services required under P.L. 102-119.

Impact test: A simulated crash condition which evaluates the ability of a vehicle or any component or device to withstand a force of 20 G's at 30 mph. Also known as sled test or crash test.

Inclusion: Integration of a student with disabilities into a regular classroom and onto a regular school bus. Also known as mainstreaming.

Incomplete vehicle: An assemblage consisting, as a minimum, of frame and chassis structure, power train, steering system, suspension system, and braking system (to extent that those systems are to be part of the completed vehicle) and requiring further manufacturing operations other than the addition of readily attachable components, such as mirrors and tire and rim assemblies, or minor finishing operations such as painting, to become a complete vehicle.

Injury accident, school bus: Injury of any pupil inside the bus, as the result of student movement.

Inspection: A close examination of a motor vehicle, performed in accordance with local, state and/or federal requirements, by an authorized agent of the local, state or federal government.

Integrated restraint system: A system in which the occupant restraint of an individual in a wheelchair/mobility aid connects directly to and is dependent upon the mobility aids securement system's rear strap assemblies.

Intermediate manufacturer: A person, other than the incomplete vehicle manufacturer or the final-stage manufacturing operations on an incomplete vehicle.

International symbol of accessibility: A white emblem on blue background used to indicate that a vehicle can accommodate individuals with disabilities.

Kneeling bus: A bus on which the front or rear end is lowered to allow easier access for passengers with disabilities.

Lap belt: A Type 1 seat belt assembly meeting the requirements of FMBSS 209, intended to limit movement of the pelvis.

Lap tray: An accessory for a wheelchair or other mobile seating device, to offer support and convenience for the occupant.

Liability insurance: Protection against the claims of others for injury or property damage. Also known as casualty insurance.

Life cycle procurement: Procurement contract based on both the initial capital cost and the cost of operation over the life of a vehicle.

Lift: See power lift.

Live time: The time when students are on the bus, beginning when the first passenger boards and ending when the last passenger leaves.

LNG: Liquid Natural Gas.

Load: To pick up students at a designated bus stop or at school.

Load factor: The ratio of passengers actually carried to the vehicle's passenger capacity.

Low-bid procurement: Competitive procedure in which the lowest bidder is awarded the contract.

Low-floor vehicle: A bus in which the floor and entrance are closer to the ground, for easier access by students with disabilities or preschoolers.

Longitudinal: Parallel to the longitudinal centerline of the vehicle, front to rear.

LPG: Liquid Petroleum Gas, also known as propane.

LRE: Least Restrictive Environment. A concept embodied in IDEA which requires that children with disabilities be integrated as fully as possible into situations and settings with their non-disabled peers.

Mainstreaming: See inclusion.

Manufacturer: Any person engaged in the manufacturing or assembling of motor vehicles or motor vehicle equipment, including any person importing motor vehicle equipment for resale.

MDC: Multi-Disciplinary Conference. An assessment meeting for a student with disabilities which leads to IEP. See also assessment team.

Medical Support Equipment: Portable equipment used by students to maintain life functions, such as oxygen bottles, intravenous of fluid drainage apparatus.

Medically fragile: Refers to students who require specialized technological health care procedures for life support and/or health support.

Minibus: A small school bus, usually a Type A1 or A2 or Type B1.

Minivan: A MPV designed to carry seven to ten passengers, which does not meet FMVSS for school buses.

Mirrors: The system of mirrors required to be installed on school buses in accordance with FMVSS 111 and applicable state laws.

> **Crossview:** Convex mirrors mounted on the front of the vehicle and designed for student detection during loading and unloading, including elliptical, quadri spherical, banana, or standard convex. Also known as system B mirrors.
>
> **Driving:** Flat and convex mirrors mounted on each side of the bus designed for viewing the road along the sides to the rear while driving. Also known as rearview, double nickel, west coast, or System A mirrors.

Mobility aid: A wheelchair or other device, either battery-powered or manual, that is used to support and convey a person with a physical disability. Also known as mobile seating device.

Modesty panel: A panel located in front of a seat or row of seats, usually supported by a stanchion and cross bar, which does not meet the performance standards of a barrier as defined in

FNFVSS 222; or a short panel which extends from the bottom of a barrier to or near to the floor for the purpose of reducing the draft from the entrance door. Also known as kick panel.

MPV: Multipurpose Passenger Vehicle. Any vehicle with a seating capacity of ten or less, including the driver, which is built on a truck chassis, or with special features for occasional off road use.

NAPT: National Association for Pupil Transportation, a membership organization comprising of primarily public fleet transportation personnel.

NASDPTS: National Association of State Directors of Pupil Transportation Services, a membership organization comprising primarily state officials responsible for pupil transportation.

National School Bus Yellow: The color defined in standard No. SBMC-008, used to identify school buses. Also known as National School Bus Chrome.

NDR: National Driver Registry.

Neutral safety switch: A device which prevents the bus from starting unless the transmission is in neutral gear or the clutch is depressed.

NGV: Natural Gas Vehicle.

NHTSA: National Highway Traffic Safety Administration, an agency of the U.S. DOT.

NIST: National Institute on Standards and Technology.

Nominal dimension: A dimension which exists in name only, e.g. 5/8 inch plywood, which is actually 19/32 inches thick, but is 5/8 inch nominal thickness. The variation between the actual dimension and the nominal dimension is the result of manufacturing practices and tolerances.

Nonconforming bus: Any vehicle designed to carry more than ten passengers this is used to transport children to or from school or school-related activities which does not meet the federal standards specific to school buses.

NPR: Notice of Proposed Rulemaking. Notice published in the Federal Register by a federal agency of a change in regulation. Follows ANPR, incorporating responses of commenter's. Also know as NPRU.

NSC: National Safety Council.

NSTA: National School Transportation Association a membership organization comprising primarily school transportation contractor companies.

NTSB: National Transportation Safety Board. An independent federal agency authorized by Congress to investigate accidents and issue recommendations.

Occupant restraints: A Type 2 seat belt assembly that meets the requirements of FMVSS 209, installed according to FMVSS 210 and used to secure the torso and pelvic area of a passenger in a motor vehicle or an occupant of a wheelchair/mobility aid..

OCR: Office of Civil Rights, an agency of the U.S. Department of Education.

OEM: Original Equipment Manufacturer.

On-board monitoring system: Computerized tracking of driver and vehicle performance, including speed, fuel consumption, etc.

Operating costs: All costs associated with running the transportation system, which are distinct from capitol costs.

Operator: The carrier who is responsible for running the transportation system, regardless of ownership of the vehicle.

OSEP: Office of Special Education Programs, an agency of the U.S. Department of Education.

OSERS: Office of Special Education and Rehabilitative Services, an agency of the U.S. Department of Education.

OSHA: Occupational Safety and Health Administration, an agency of the U.S. Department of Labor.

OTETA: The Omnibus Transportation Employees Testing Act of 1992, requiring drivers holding CDL's to participate in a drug and alcohol testing program.

Overall vehicle width: The nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, and mud flaps, determined with the doors and windows closed and the wheels in the straight-ahead position.

Overhang: The distance from the center of the rear axle to the rear most end of the body or from the center of the front axle to the forward edge of the front bumper.

Out-of-Service: A vehicle out of service due to in operability.

P.A. system: Public address system which allows the driver of a bus to communicate with person's inside and/or outside the bus through a speaker installed on the inside and/or outside of the bus. Also known as external loudspeaker.

Parallel restraint system: A system in which the occupant restraint lap belt anchors directly to the floor track or plates, and is independent of the wheelchair/mobility aid securement system.

Paratransit: Public transit service which is more flexible than fixed route, commonly provided special service for elderly and disabled passengers.

Part B: Refers to the section of the EHA applicable to special education and related services for children with disabilities, and the implementing regulations at 34 CFR 300.

Part H: Refers to the section of the IDEA related to early intervention services for infants and toddlers, and the implementing regulations at 34 CFR 303.

Particulate trap: A device on diesel buses to clean the exhaust of particulate matter.

Passenger miles: The total number of miles traveled by the aggregate number of passengers on a vehicle; e.g. ten students traveling ten miles on one bus equals 100 passenger miles.

P.L. 94-142: see EHA.

Postural support: A seat, belt, or other component used to support a child with disabilities in a desired position, but not designed or intended to provide occupant restraint in a crash. Also known as positioning device.

Power base: A powered wheeled platform used to mount a seating device for carrying an individual with a disability, usually characterized by smaller diameter tires.

Power cut-off switch: a device that cancels all power from the vehicle batteries.

Power lift: A mechanized platform designed to provide access to a vehicle for an occupied mobility wheelchair. Also known as a wheelchair lift.

Positive-locking: A design feature of the mobility aid securement and occupant restraint system where the attachment and anchoring hardware cannot be inadvertently released or disengaged once properly installed.

Post-trip interior inspection: A check of the interior of the bus by the driver at the end of the run to ensure that no sleeping children or student belongings have been left behind.

Powertrain: The group of components used to transmit engine power to the wheels. Includes transmission universal joints, driveshaft, drive axles, and gears. Also known as drivetrain.

Preschool: Refers to a child between the ages of three and five years who is not yet in kindergarten; or to a program serving children in that age range.

Pre-trip inspection: A systematic inspection of the bus by the driver before every trip or shift to ensure that the b us is in safe operating condition. The same procedure performed after the trip/shift is the post-trip inspection.

Privatization: The process of transferring the operation of public services from the public agencies to private companies or nonprofit organizations. Also known as contracting or outsourcing.

Pusher: A school bus in which the engine is mounted in the rear of the vehicle. Also known as rear engine bus.

Pushout window: A bus window that is hinged at the top or front to enable the window to be swung upward or outward relative to the side of the bus and provide a means of emergency egress from the bus. Also known as emergency window.

Railroad crossing: The intersection of a highway, street, roadway and railroad tracks. Also known as grade crossing.

Ramp: An inclined plane for use between the ground and the floor of the vehicle to permit access by person in wheelchair/mobility aids.

Reflective: Refers to the property of materials that cause them, when they are illuminated, to reflect the fight to some extent.

Related services: Transportation and other supportive services that are required to assist a child with a disability.

Remanufacture red: Refers to a vehicle component that has been structurally restored.

RESNA: Rehabilitation Engineering Society of North America, an organization engaged in research and development of assistive technology for persons with disabilities.

Restraining barriers: An assembly similar to a seat back located immediately in front of a single school bus passenger seat or row of seats to provide crash protection in accordance with FMVSS 222. Also known as barrier, crash barrier, and seat barrier.

Restraint system: A generic term for one or more devices intended to secure and protect a passenger with or without a mobility aid in a vehicle, including seat belts, occupant restraints, child safety seats, safety vests, etc.

Retractor, automatic-locking: A retractor incorporating adjustment by means of a positive self-locking mechanism which is capable of withstanding restraint forces.

Retractor, emergency-locking: A retractor incorporating adjustment by means of a locking mechanism that is activated by vehicle acceleration, webbing movement relative to the vehicle, or automatic action during an emergency, and is capable of withstanding restraint forces.

Retroreflective: Refers to material that is designed to return illumination of the material directly or generally back to the source of illumination.

RFP: Requests for proposals. An invitation to submit a contract proposal, less restrictive than an invitation to bid on a contract.

Ridership: The number of passengers using a transportation system during a given time period.

Rim: The part of the wheel on which the tire is mounted and supported.

Rolling stock: The vehicles in a transportation system.

Roof hatch: See emergency roof exit.

Route: A designated course regularly traveled by a school bus to pick up students and take them to school, or to deliver students from school to their homes or designated bus stops.

Route miles: The total number of miles in one or more routes in the system.

Route sheet: A list of all the designated stops on a route.

Run: A complete trip on a route. (To illustrate the difference between a run and a route: it is possible to have six daily runs on the same route, i.e., one high school, one middle school, and one elementary run both morning and afternoon).

Running lights: Headlights that operate automatically at a reduced voltage during the day to increase the vehicle's visibility. Also known as daytime running lights.

SAE: Society of Automotive Engineers, the leading standards-writing organization for the automotive industry.

SAP: Substance Abuse Professional. A licensed physician, psychologist, social worker, or alcohol and drug counselor who is required to evaluate any employee who violates a carriers drug and alcohol testing program.

Safety vest/harness: A upper torso restraint that supports and secures a child by attachment to the vehicle seat.

SBMTC: School Bus Manufacturers Technical Council, formerly SBMI. A membership organization within NASDPTS which serves as technical advisor regarding school buses.

School: A educational institution for children at the pre-primary, primary, elementary, or secondary level, including nursery schools and head start programs, but no including day care programs.

School bus equipment: Equipment designed primarily as a system, part, or component of a school bus, or any similar part or component manufactured or sold for replacement or as an accessory or addition to a school bus.

School Bus Manufacturers Technical Council: Formerly SBMI. A membership organization within NASDPTS which services as technical advisor regarding school buses.

School trip: See activity trip.

School van: A vehicle smaller than a bus, designed to carry seven to ten passengers and used to transport students, that does not meet FMVSS for school buses. See minivan.

School vehicle: Any vehicle owned, leased, contracted or operated by a school or school district and regularly used to transport students to and from school or school-related activities. Includes school buses, activity buses, vans, and passenger cars, but does not include transit or charter buses.

Seat: A device designed and installed to provide seating accommodations.

> **Activity seat:** A seat designed for passenger comfort with contoured seats and backs with the result that passenger's positions are distinctly separate, characterized by fixed seat backs; may have arm rests and head rests. Can be manufactured to meet FMVSS 222.
>
> **Bench seat:** A seat designed to accommodate more than one passenger with no apparent partitioning between positions, which is characterized by fixed legs and a fixed back, i.e. the standard school bus seat which meets FMVSS 222.
>
> **Davenport seat:** A bench seat that extends from side wall to side wall at the rearmost seating position in the bus; not permitted in school buses.
>
> **Flip seat:** A school bus bench seat designed so that the cushion flips up when the seat is not occupied, similar to a theater seat; used to provide aisle clearance when a passenger seat is located adjacent to a side emergency door.
>
> **Integrated child safety seat:** A child safety seat meeting the requirements of FMVSS 213 which is built into and an integral part of a bench seat.
>
> **Jump seat:** A seat designed to fold down to provide supplemental seating in a bus, e.g. in the aisle, in front of the door or along the side wall; not permitted in school buses.
>
> **Reclining seat:** An activity seat with a reclining seat back; not permitted in a school bus.

Seat belt: A passenger restraint system incorporating lap belts or lap and shoulder belts and meeting the requirements of FMVSS 208, 209, and 210. Also known as seat restraints.

Seating capacity: The number of designated seating positions provided in a vehicle, including the driver's position. In determining seating capacity, each wheelchair securement location shall be counted as 4 designated seating positions.

> **Designed seating capacity:** The theoretical passenger capacity that a vehicle would have if it were constructed with the maximum number of seating positions according to standard seating plans. Also known as manufacturer's seating capacity.
>
> **Reduced capacity:** The capacity that is achieved when one or more seats are removed from the standard design during or after manufacture of the vehicle.

Seat position: The space on a school bus bench seat designated for one student. The number of such positions per seat is determined by dividing the width of the seat by 15 inches and rounding to the nearest number, as described in DFR 49 571.3.

Seating reference point: The manufacturer's design point, with coordinates relative to the vehicle structure, which establishes the rearmost normal driving or riding position of each designated seating position and simulates the position of the pivot center of the human torso and thigh.

Seat restraints: See seat belt.

Section 402: Section of 23 CFR that authorizes grant funds for highway safety projects.

Section 504: Section of the Rehabilitation Act of 1973, PL 93-112, which prohibits discrimination against individuals with disabilities by an recipient of federal funding.

Securement points: Locations on the base or seat frame of the wheelchair/mobility aid where the securement system should be attached.

Securement system: The means of securing a mobile seating device to a vehicle in accordance with FMVSS 222, including all necessary buckles, anchors, webbing/straps, and other fasteners.

Securement and restraint system: The total system which secures and restrains both a wheelchair/mobility aid and its occupant. Also known as WTORS.

Self-insured: Refers to a company of school district which provides reserved funds against claims or losses.

Sensor: An electronic device installed on a school bus for the purpose of detecting animate objects in the loading zone. Also known as object detection system.

Skid plate: Stout metal plate attached to the underside of a vehicle to protect the oil pan, transmission, step well, or fuel tank from scraping on rocks, curbs and road surface.

Slack adjuster: Adjustable device connected to the brake chamber push rod used to make up for brake shoe wear.

SOS lights: Stop on Signal lights. See alternately flashing signal lights.

SOWAT: The Subcommittee on Wheelchairs and Transportation, a group acting under the auspices of RESNA to develop transportable wheel chair standards.

Special education: Specially designed instruction to meet the unique needs of a child with disabilities.

Special equipped school bus: Any school bus designed, equipped, or modified to accommodate students with special needs.

Split-brake system: A service brake system with two separate hydraulic circuits which, upon failure of either, retains full or partial braking ability.

Stanchion: An upright post or bar, usually installed from floor to ceiling in a bus that provides support for other structural members and/or provides a hand-hold for passengers.

State director: The chief government administrator in charge of a state's pupil transportation program and responsible for oversight of regulatory functions.

Stop arm: A device in the form of a red octagon extending outward from the side of a school bus to signal that the bus has stopped to load or unload passengers and meeting FMVSS 131. Also known as stop semaphore and stop signal arm.

Stopping distance: Braking distance plus reaction distance.

> **Braking distance:** The distance a vehicle travels between the time the brakes are applied and the time forward motion ceases.
>
> **Reaction distance:** Distance a vehicle travels during the time it takes for a driver to recognize the need to stop and to apply the brakes.

Strobe light: A bright short duration light that flashes as a result of an electronic discharge of electricity through a gas.

Student: Any child who attends a school, as previously define.

Student rides: The number of students transported in a given system multiplied by the number of one-way trips in a school bus, e.g. a school district that transports 1000 students provides 2000 student rides daily, or 360,000 students rides to and from school annually. To determine the total number of students rides annually, the district would add the actual or estimated number of students transported on activity trips (times 2) to the figure above.

Substitute driver: A driver who is not assigned to a regular routed, but is employed to provide immediate coverage when necessary due to driver absences or emergencies. Also known as spare driver and extraboard driver.

Surrogate wheelchair: A prototype which is subjected to impact tests.

Suspension system: The components of the vehicle that transmit the load of the vehicle's weight from the chassis framework to the ground, including the springs, axles, wheels, tires, and related connecting components.

TDD: Telecommunication devices for the deaf.

Temperature control system: The means of heating or cooling the interior of the vehicle.

Tether: An anchor strap used in addition to a seat belt to hold certain types of restraint devices in place.

Tie-down system: See securement system.

Tire: The continuous solid or pneumatic rubber elastomeric cushion encircling a wheel intended for contact with the road.

> **Bias ply:** A pneumatic tire in which the ply cords extending to the beads are laid at alternate angles substantially less than 90 degrees to the centerline of the tire.
>
> **Low profile:** A tire has a section height that is less than 85% of its nominal section width, i.e. a tire with an aspect ration of less than 0.85.
>
> **Radial:** A pneumatic tire in which the ply cords which extend to the beads are laid substantially at 90 degrees to the centerline of the tread.
>
> **Retread:** A worn tire casing to which tread rubber has been affixed to extend the usable fife of the tire. Also known as re-capped or retreaded tire.
>
> **Siped:** A tire which has been scored or cut perpendicular to the direction of rotation (across the tread) to improve traction.
>
> **Snow:** A tire with an obvious aggressive or lug type tread across the entire width which is designed to be self-cleaning.
>
> **Studded:** A tire to which metal protrusions have been added to improve traction.

Tire cords: The strands forming the reinforcement structure in a tire.

To-and-from school: Transportation from home to school and from school to home; also transportation from school to school or from school to job training site.

Tow hooks: Attachments on the chassis frame for use in towing the vehicle backwards or forwards. Also known as tow eyes.

Track seating: Seating system in which seating units, including mobility aids, are secured to the vehicle structure by attaching them to tracks on the vehicle floor.

Transverse: Perpendicular to the longitudinal centerline of the vehicle, i.e. from side to side.

Trip: The transportation of students from school to any destination, followed by a return trip back to school. The two together make a round trip.

Tripper service: Regularly scheduled mass transit service which is open to the public, and which is designed or modified to accommodate the needs of school students and personnel, using various fare collections or subsidy systems. Must be part of the regular route service as indicated in published route schedules.

Turbocharger: A device which uses the pressure of exhaust gases to drive a turbine that, in turn, pressurizes air normally drawn into the engine's chambers.

Turnkey: Partial privatization in which a school districts hires a company to supply drivers, maintenance management, and/or vehicles.

Two-way radio: Electronic communication system which uses a designated air way for transmission between a bus and a base station.

UCRA: Universal Child Restraint Anchorage. A standardized means of installing child restraint systems in vehicles that is independent of the seat belt system. UCRA's will be required equipment on all new motor vehicles under 10,000pounds, including school buses, as of September 2002.

Unload: To discharge passengers from a school bus.

Unloaded vehicle weight: The weight of vehicle with a maximum capacity of all fluids necessary for operation, but without cargo or occupants or accessories that are ordinarily removed from the vehicle when they are not in use.

Universal precautions: Method of infection control designed to protect the individual from exposure to disease, which requires that all bodily fluids and secretions are treated as though they were infectious.

UST: Underground Storage tank.

Vaporlock: Boiling or vaporization of fuel in the lines from excessive hear, which interferes with liquid fuel movement and in some cases stops the flow.

Video system: A means of monitoring student behavior in a school bus. The system includes one or more video cameras to tape activity. Camera housing unites mounted in each bus appear to hold a camera, whether or not one is actually in place. Also known as surveillance.

VIN: Vehicle Identification Number. A series of Arabic numbers and Roman letters which is assigned to a motor vehicle for identification purposes.

Viscosity: A measure of internal resistance to flow or motion offered by a fluid lubricant.

Weather emergencies: Weather conditions that require a deviation from normal transportation, e.g. flooding, snowstorm.

Weight distribution: The distribution proportion of the vehicle load divided between the front and rear axles.

Wheel: A rotating load-carrying member between the tire and the hub, usually consisting of two major parts, the rim and the wheel disc, which may integral, permanently attached, or detachable.

> **Ball seat nut mounting:** A wheel mounting system wherein the wheel centering is provided by the wheel mounting studs and the ball seat nuts which, when properly tightened, assure the centering alignment of the wheel.
>
> **Disc:** The part of the wheel which is the supporting member between the hub and the rim.
>
> **Disc Wheel:** A permanent combination of a rim and wheel disc.
>
> **Hub:** The rotating outer member of the axle's assembly which provides for wheel disc mounting.
>
> **Locking ring:** A removable, split rim ring that holds the rim flange in place on a multi-piece rim.
>
> **Piloted hub mounting:** A wheel mounting system wherein the wheel centering is provided by a close fit between the wheel disc and the hub.
>
> **Rim:** The part of the wheel on which the tire is mounted and supported.
>
> **Spoke wheel:** A rotating member which provides for mounting and support of one or two demountable rims, Also known as wheel for demountable rim.

Wheelbase: The distance between the front and rear axles.

Wheelchair: A seating system comprising at least a frame, seat, and wheels, for the support and mobility of a person with physical disabilities. Also known as mobile seating device.

Wheelchair lift: See power lift.

ZEB: Zero-emissions bus.

ZEV: Zero-emissions vehicle.

APPENDIX B

School Bus Chassis and Body

NATIONAL SCHOOL BUS YELLOW

The color known as National School Bus Yellow is specified and described in the School Bus Manufacturers Technical Council publication "National School Bus Yellow Color Standard" (SBMTC-008)

NOISE TEST PROCEDURE

1. The vehicle is located so that no other vehicle or signboard, building, hill, or other large reflecting surface is within 15.2 m (50 feet) of the occupant's seating position.

2. All vehicle doors, windows, and ventilators are closed.

3. All power-operated accessories are turned off.

4. The driver is in the normal seated driving position and the person conducting the test is the only person in the vehicle.

5. A sound level meter is used that is set at the A-weighting fast" meter response and meets the requirements of:

    a. The American National Standards Institute, Standard ANSI S1.4-1971. "Specifications for Sound Level Meters," for Type 1 Meters; or

    b. The International Electrotechnical Commission (IEC), Publication No. 179 (1973). "Precision Sound Level Meters".

6. The microphone is located so that it points vertically upward 6 inches to the right and directly in line with and on the same plane as the occupant's ear adjacent to the primary noise source.

7. If the motor vehicle's engine radiator fan drive is equipped with a clutch or similar device that automatically either reduces the rotational speed of the fan or completely disengages the fan from its power source in response to reduced engine cooling loads, the vehicle may be parked before testing with its engine running at high idle or any other speed the operator chooses for sufficient time, but not more than 10 minutes, to permit the engine radiator fan to automatically disengage.

8. With the vehicle's transmission in neutral gear, the engine is accelerated to:

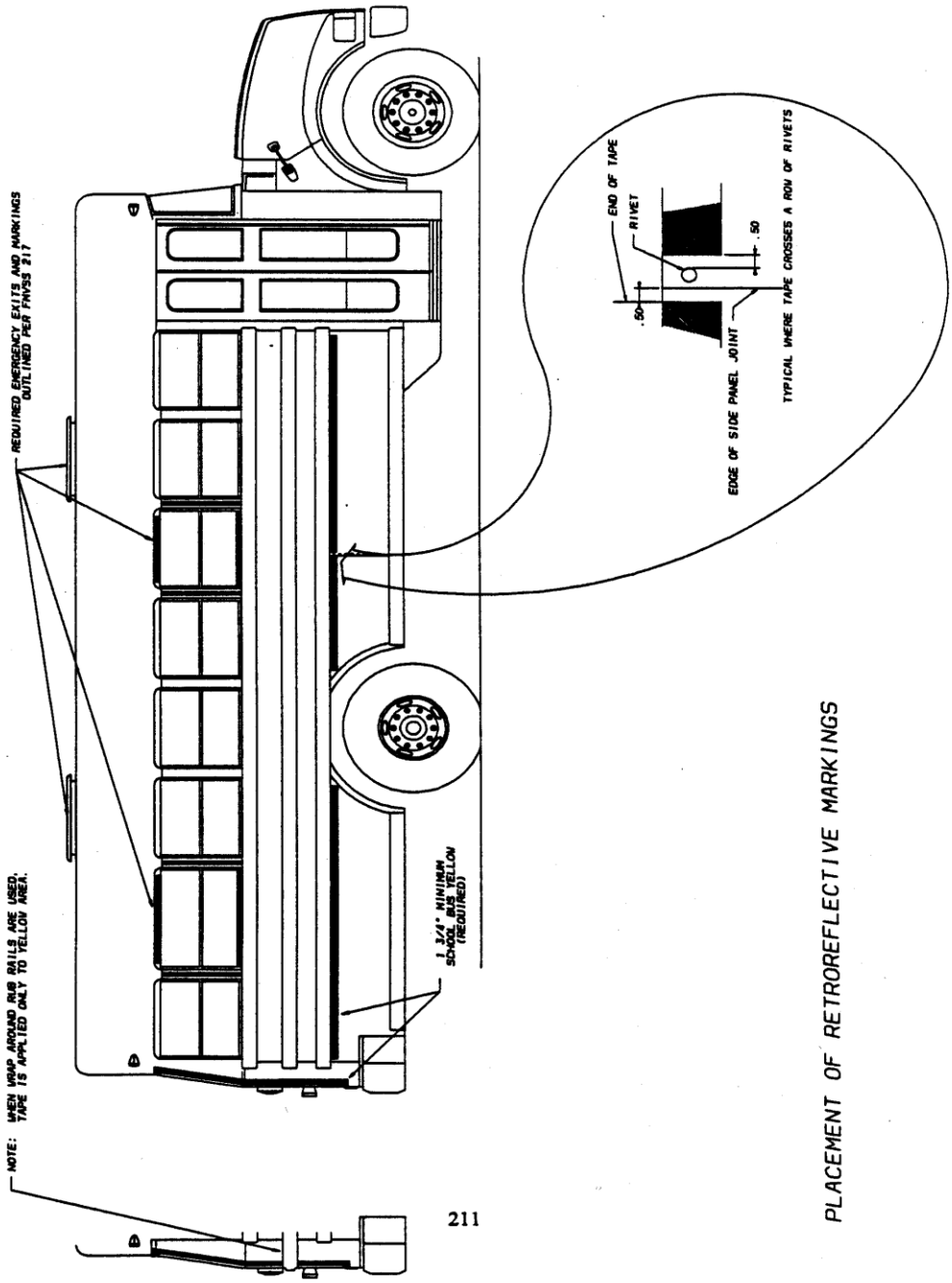
a. It's maximum governed speed, if it is equipped with an engine governor, or

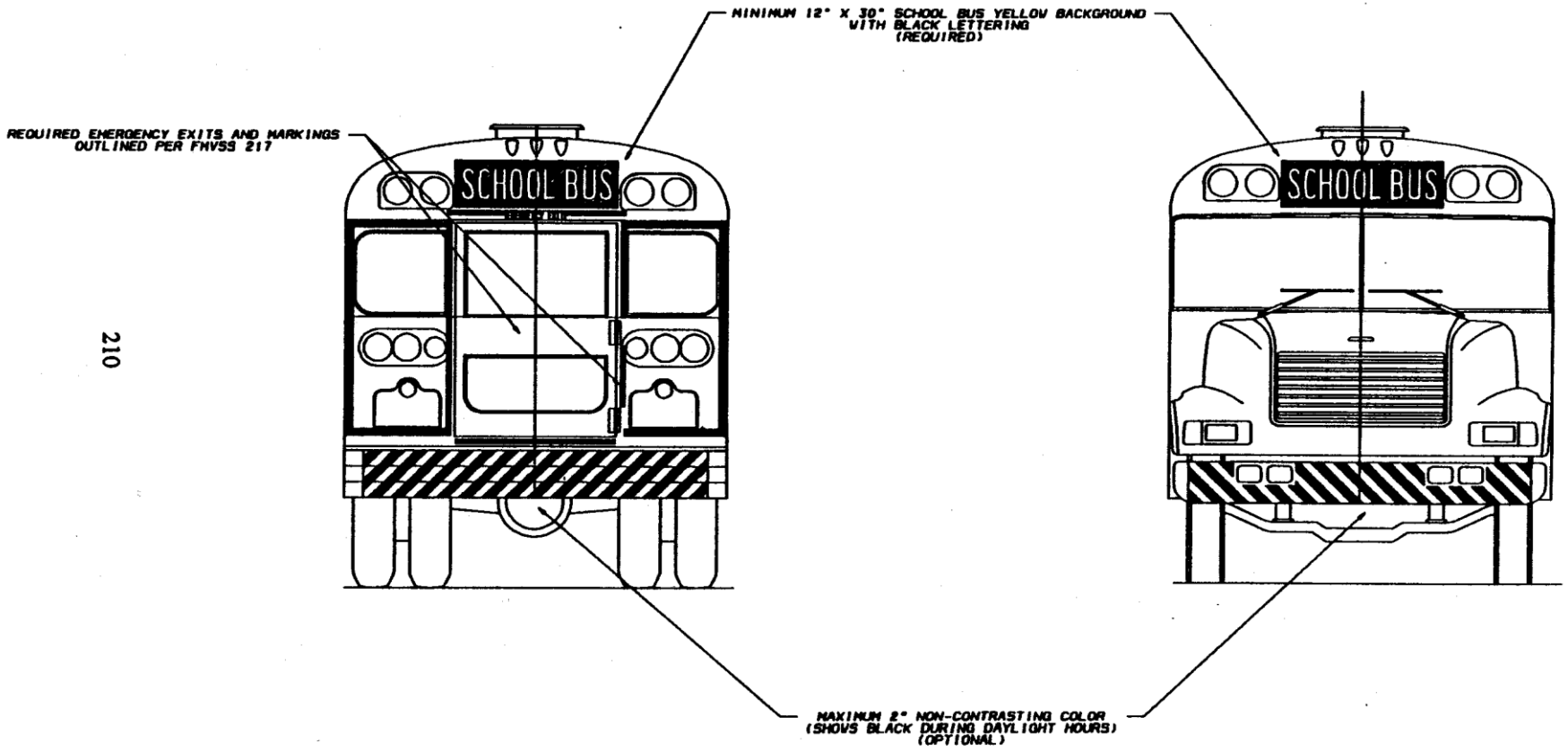
b. It's speed at its maximum rated horsepower, if it is not equipped with an engine governor, and the engine is stabilized at that speed.

9. The A-weighted sound level reading on the sound level meter for the stabilized engine speed condition referred to in H.1. or H.2. above is observed and, if it has not been influenced by extraneous noise sources, it recorded.

APPENDIX C

Reflective Materials





PLACEMENT OF RETROREFLECTIVE MARKINGS

APPENDIX D

Specifications for Surrogate Wheelchair

D.1 Purpose

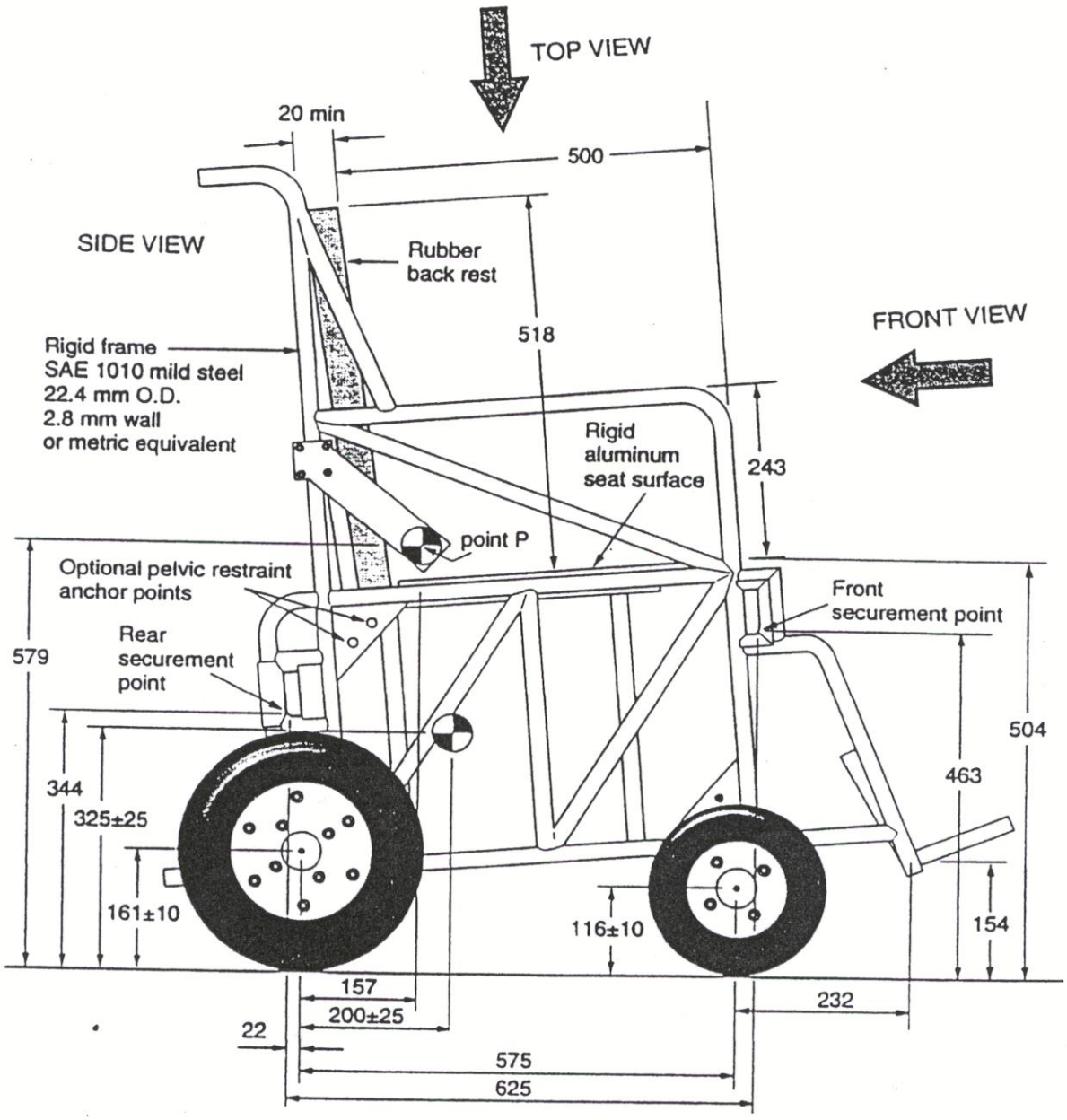
This appendix provides design, dimensional, material, and performance specifications for the surrogate wheelchair (SWC) referenced in the design requirements and tests of this recommended practice. These specifications are intended to provide a repeatable and reusable device that represents a typical adult-sized power wheelchair. Details for the design, fabrication, and maintenance of a suitable surrogate wheelchair are available in SAE J2252 Surrogate Wheelchair Drawing Package and Maintenance Manual.

D.2 Specifications

The surrogate wheelchair should be designed and fabricated with the features, dimensions, and specifications shown in Figures D.1 through D.3, and should:

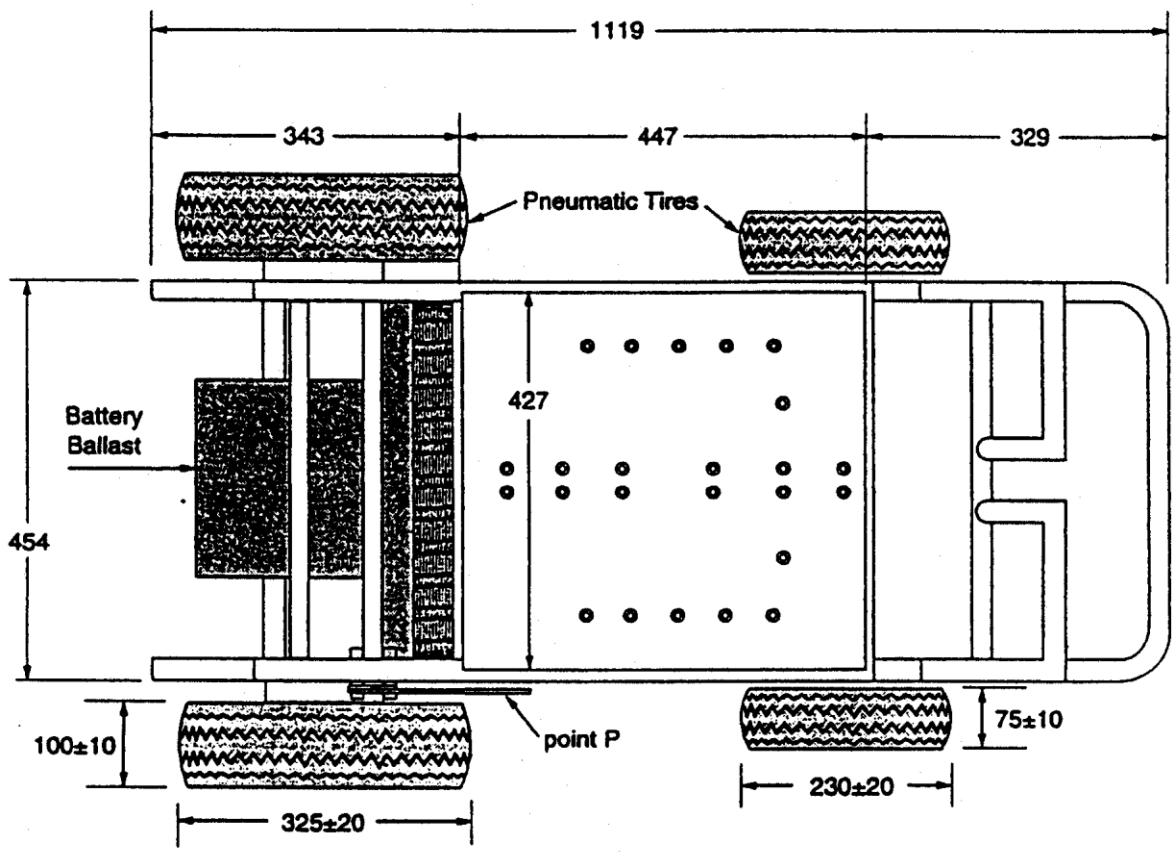
a. Be of rigid construction;
b. Have a total mass of 85 $\pm$ I kg;
c. Have a lower frame design that is compatible with WTORS components of docking-type and clamp-type wheelchair tiedowns with little or no modification to those components;
d. Allow for adjustment in the SWC-to-floor clearance distance to accommodate;
e. Wheelchair anchorage components of docking-type tiedown systems, have a center of gravity located 200 $\pm$ 25 min forward of the rear axle and 325 $\pm$ 25 mm above the e. ground plane for the range of frame-to-floor clearance adjustments allowed;
f. Provide two front securement points and two rear securement points for straptype **tiedowns at the locations indicated in Figure D.** I and with the geometry specified in Figure F.1 of Appendix F;
g. Provide accessible and structurally sound locations 250 $\pm$ 10 mm above the ground plane for the addition of two rear securement points that simulate the horizontal axles a standard welded-frame wheelchair and that are perpendicular to the Surrogate wheelchair sideframe;
h. Provide pelvic restraint anchor points on both sides that are located so that the angle of a pelvic restraint bolted to these points and placed over the pelvis of a 50th-percentile-male ATD seated in the surrogate wheelchair forms an angle between 45 and 60 degrees to the horizontal;
i. Have a rigid, flat seat surface with dimensions shown in Figures D.2 that is oriented at an angle of 4 $\pm$ 1.5 degrees to the horizontal (front end up) when the SWC tires are resting on a flat horizontal surface;
j. Have a rigid seatback with height and width dimensions indicated in Figure D.3 that is oriented at 8 $\pm$ 1.5 degrees to the vertical when the inflated tires of the SWC are resting on a flat horizontal surface;

k. Have a 20-mm minimum thickness, perforated rubber pad with height and -width dimensions indicated in Figures D. I and D.3 fixed to the front surface of the rigid seatback;
l. be of durable construction such that there is no permanent deformation of the frame, seat surface, or seatback in a 48-km/h, 20-g frontal -impact test with a 50th-percentile, 73.5 kg ATD positioned and restrained in the SWC;
m. Have a detachable but rigid mounting plate for placement of a side-view contrast target at the location of reference point P outboard of tiedown and restraint system components on either side of the SWC;
n. Have pneumatic front tires that, when inflated to 759 kPa, have a diameter of 230 $\pm$ 10 mm, a width of 75 $\pm$ 5 mm, and a sidewall height of 54 $\pm$ 5 mm,
o. |Have pneumatic rear tires that, when inflated to 414 kPa, have a diameter of 325 $\pm$ 10 mm, a width of 100 $\pm$ 10 mm, and a sidewall height of 70 $\pm$ 5 min;
p. include hard rubber stops located inboard of each rear wheel to limit rear tire compression during the frontal impact test of Appendix A to 45 $\pm$ 5 mm.



all dimensions are in mm with tolerances of ± 2 mm unless specified

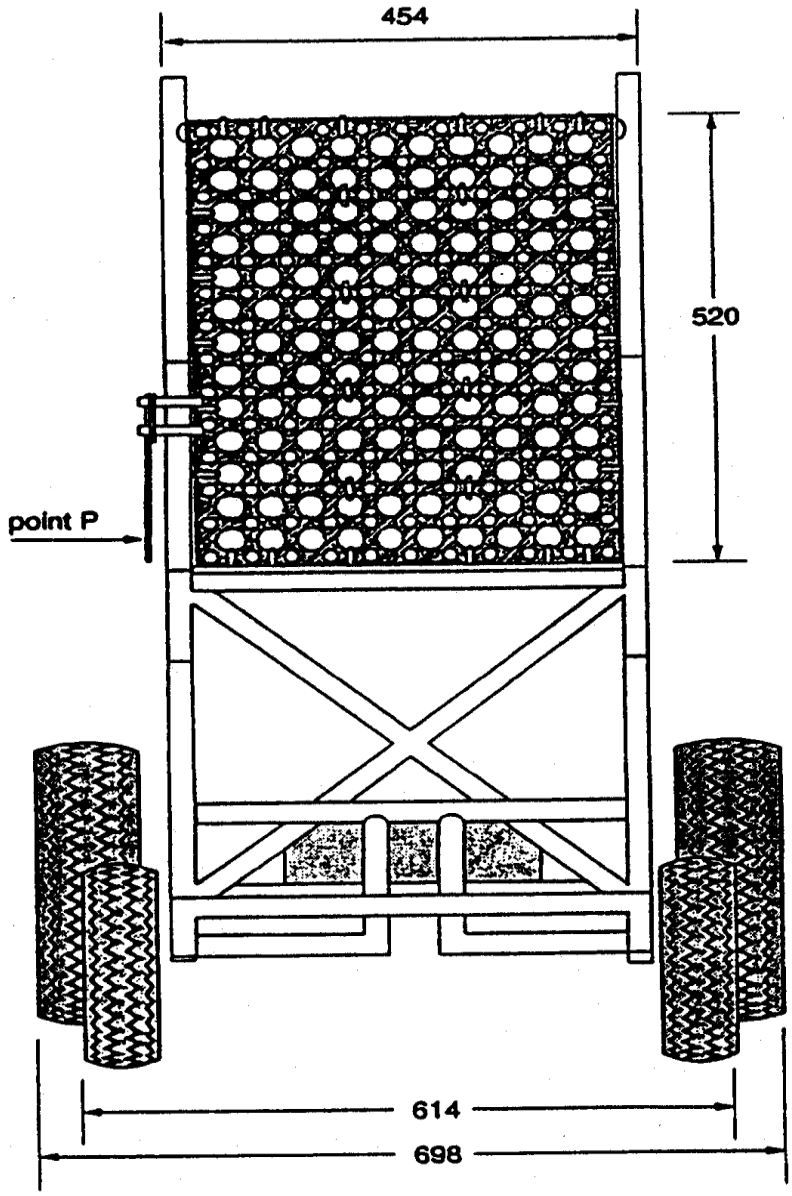
Figure D.1 - Side-view drawing of surrogate wheelchair.



all dimensions are in mm with tolerances of ± 2 mm unless specified

Figure D.2 - Top-view drawing of surrogate wheelchair.

FRONT VIEW



all dimensions are in mm with tolerances of ± 2 mm unless specified

Figure D.3 - Front-view drawing of surrogate wheelchair.

VEHICLE RAMP 36 CFR 1192.23

1) **Vehicle ramp.** -(1) Design Load. Ramps 30 inches or longer s should-support a load of 600 pounds, placed at the centroid of the ramp distributed over an area of 26 inches by 26 inches, with a safety factor of at least 3 based on the ultimate strength of the material. Ramps shorter than 230 inches should-support a load of 300 pounds.

2) **Ramp surface.** The ramp surface should-be continuous and slip resistant; should not have protrusions from the surface greater than 1/4 inch high; shall have a clear width of 30 inches; and shall accommodate both four-wheel and three-wheel mobility aids.

3) **Ramp threshold.** The transition from roadway or sidewalk and the transition from vehicle floor to the ramp may be vertical without edge treatment up to 1/4. Changes in level between 1/4 inch and 1/2 inch should-be beveled with a slope no greater than 1:2.

4) **Ramp barriers.** Each side of the ramp should have barriers at least 2 inches high to prevent mobility aid wheels from slipping off.

5) **Slope**. Ramps should have the least slope practicable and should not exceed 1:4 when deployed to ground level. If the height of the vehicle floor from which the ramp is deployed is 3 inches or less above a 6-inch curb, a maximum slope of 1:4 is permitted; if the height of the vehicle floor from which the ramp is deployed is 6 inches or less, but greater than 3 inches, above a 6-inch curb, a maximum slope of 1:6 is permitted; if the height of the vehicle floor from which the ramp is deployed is 9 inches or less, but greater than 6 inches, a maximum slope of 1:8 is permitted; if the height of the vehicle floor from which the ramp is deployed is greater than 9 inches above a 6-inch curb, a slope of 1:12 shall be achieved. Folding or telescoping ramps are permitted provided they meet all structural requirements of this section.

6) **Attachment.** When in use for boarding or alighting, the vehicle so that if is not subject to displacement when loading or unloading a heavy power mobility aid and that no gap between vehicle and ramp exceeds 5/8 inch.

7) **Stowage.** A compartment, securement system, or other appropriate method may be provided to ensure that stowed ramps, including portable ramps stowed in the passenger area, do not impinge on a passenger's wheelchair or mobility aid or pose any hazard to passengers in the event of a sudden stop or maneuver.

8) **Handrails.** If provided, handrails should allow persons with disabilities to grasp them from outside the vehicle while starting to board, and to continue to use them throughout the boarding process, and shall have the top between 30 inches and 38 inches above the ramp surface. The handrails shall be capable of withstanding a force of 100 pounds concentrated at any point on the handrail without permanent deformation of the rail or its supporting structure. The handrail should have a cross-sectional diameter between 1-1/4 inches and 1-1/2 inches or should provide an equivalent grasping surface, and have eased edges with corner radii of not less than 1/8 inch. Handrails should not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

APPENDIX, VEHICLE

*SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
400 COMMONWEALTH DRIVE
WARRENDALE, PA 15096 (412)776-4841

*SCHOOL BUS MANUFACTURERS INSTITUTE
DIVISION OF TRUCK BODY AND EQUIPMENT ASSOCIATION
4907 CORDELL AVE.
BETHESDA, MD 20814 (301)652-8004

*UNDERWRITERS LABORATORIES, INC.
333 PFINGSTEN RD.
NORTHBROOK, ILLINOIS 60062

*PRODUCT STANDARD PSI-66
U.S. DEPARTMENT OF COMMERCE
14th AND E STREETS
WASHINGTON, D.C. 20230

*AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 RACE STREET
PHILADELPHIA, PA 19103

*FEDERAL SPECIFICATION TT-C-520b
GENERAL SERVICES ADMINISTRATION
SPECIFICATIONS AND CONSUMER INFORMATION
DISTRIBUTION CENTER
WASHINGTON NAVY YARD
BUILDING 197
WASHINGTON, D.C. 20407

APENDIX E

Handrail Inspection Tool & Procedures

The Handrail Inspection Tool and Procedure

The inspection tool (Figure 6) is inexpensive and tile procedure for detecting potentially fatal hand rail designs is quite simple. The inspection tool is a standard 1 /2" hex nut measuring 3/4" across tile fiats. This nut is tied to 1/8"thick cotton cord measuring 36" in length with overhand knots. Tile drawstring should have a minimum length of 30" when tied to the nut and attached so that a Pull of at least ten pounds does not separate tile nut from or break the drawstring.

Steps to conduct a handrail inspection are:

a. Stand oil the ground outside of tile bus.
b. Drop the inspection tool between the handrail and step well wall, simulating the typical way students exit the bus.
c. Draw the inspection tool through the handrail in a smooth, continuous slow motion.
d. Repeat this procedure several times (minimum of three times)

Note: It is important to drop the inspection tool over the handrail in such a way as to simulate 1 child exiting the bus. This is a *drop and drag* test. Do not create a snagging situation by placing the nut in an area that would not be exposed to a drawstring or other articles.

Inspection Results

a. Take the bus but of service and repair it if tile inspection tool catches or snags anywhere on the handrail.
b. If tile nut separates from the drawstring or the drawstring breaks, reassemble the tool and retest. If the inspection tool pulls freely without catching or snagging, the bus should not be rejected.

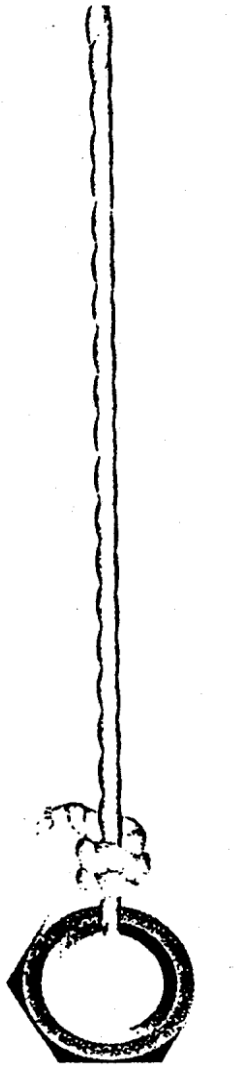


Figure 6
The Tool

APPENDIX F

Alternative Fuels

CHARACTERISTICS OF ALTERNATIVE FUELS

For the purpose of this standard, alternative fuels refer to the specific fuels listed below. A brief description of each fuel and the advantages and disadvantages of each fuel are shown. Also see Appendix C, Alternative Fuels Comparison Chart.

Note: There are two other more exotic fuels being examined, hydrogen and solar power. These two energy sources are in their infancy as alternative fuels for motor vehicles, and are not covered within the scope of this document.

1. Liquid alternative fuels

   a. **Methanol:** Methanol, a liquid at normal ambient temperatures, is colorless, and is made primarily from natural gas or coal. Extensive experiments have been conducted with auto and truck engines powered by methanol. There are a number of urban transit bus fleets currently using methanol; California has experience with methanol as an alternative fuel for school buses through their School Bus Demonstration Project. The findings clearly determined methanol fuel to be costly to operate and unreliable.

      1) **Advantages:**

         a. The principal advantage to methanol is that the emissions produced are quite low in particulates and NOx.

         b. Another major advantage is that it mixes with gasoline and can be used as M85 which is 15% gasoline and 85% Methanol. Also, flexible fuel vehicles run on a blend of the two fuels.

         c. Methanol has a high octane rating which assists gasoline (spark ignition) engine performance.

         d. Methanol is biodegradable and readily assimilates with water.

         e. Methanol burns smokeless.

         f. Methanol is a domestically produced energy source.

2) **Disadvantages:**

a. Methanol is corrosive, particularly to aluminum'. engines and fuel systems specially designed to handle it use different materials, such as stainless steel.

b. Methanol has less than half the power per equivalent gallon (BTU value) as that of diesel fuel for an equivalent range, this requires storage tanks twice the size of diesel tanks.

c. Methanol is quite toxic. Direct exposure to the human body has the potential of causing blindness and kidney failure. Since it is tasteless and colorless, it cannot be easily detected should it get into a water supply.

d. Methanol combustion generates high amounts of formaldehyde, a potential cancer causing substance. This can be offset with exhaust after treatment, such as special catalytic converters.

e. In its pure state, methanol burns with a colorless flame, so a fire is hard to see. It is less volatile than gasoline but has a relatively low flash point of 54 degrees Fahrenheit.

f. The distribution system and infrastructure for methanol fueling are considerably less widespread than for gasoline and diesel.

a. Methanol has a low cetane rating, which inhibits diesel engine performance. It is not suitable for blending with diesel fuel.

b. Methanol has been proven to be unsafe when operating in certain ambient temperature ranges.

b. Ethanol:

Ethanol is a distilled agricultural alcohol product that is a liquid at normal ambient temperatures and is colorless. Corn is the current primary grain source. It has many of the same characteristics as methanol. Currently ethanol is used primarily in a mixture with gasoline, usually no more than 10% ethanol.

1) **Advantages:**

a. Ethanol emissions are quite low in particulates and NOx.

b. Like methanol, ethanol readily mixes with gasoline.

c. Ethanol is biodegradable and readily assimilates with water.

d. Ethanol is less corrosive and less toxic than methanol.

e. Ethanol is a domestically produced energy source.

2) **Disadvantages:**

a. The production process is extensive and the steps involved, i.e., planting, fertilizing, harvesting, shipping, processing, consume nearly as much energy as is created.

b. The energy output of ethanol, though higher than methanol, is still only about half that of diesel fuel, thus the range of ethanol powered vehicles is limited for a given fuel storage capacity.

c. Ethanol emissions have some visible smoke.

d. Ethanol produces formaldehyde; however, this can be offset with an exhaust after treatment.

e. The distribution system and infrastructure for ethanol fueling are considerably less widespread than for gasoline and diesel.

c. Clean diesel:

Clean diesel was one of the alternative fuels approved in the Clean Air Act Amendments of 1990. The first step being undertaken is further refining to reduce sulfur content and hence the significant particulate emissions caused by the sulfur. Significant advancement in this process has resulted *in the development of ultra low sulfur content diesel fuel. Refinery techniques can now produce diesel fuel with a sulfur content below 15 parts per million (PPM). The availability of this fuel supports the installation of an advanced exhaust after treatment device in the form of a continuously regenerating trap (CRT). This CRT technology reduces the exhaust particulate content by approximately 90% from currently mandated levels (to .01 grams/hp hr) and the hydrocarbons to an unmeasurable level (to essentially zero). Further steps are being developed to add cetane boosters which increase efficient combustion.

1) **Advantages:**

a. The additional processing costs are small, so clean and ultra low sulfur diesels are cost effective relative to other alternative fuels.

b. All existing diesel engines currently in service can use clean or ultra low sulfur diesel without modification.

c. The present systems for distribution of diesel fuel are unchanged and are fully usable with clean diesel.

d. Clean and Ultra low sulfur diesel retains the low level of diesel fuel volatility. This makes it safer than many of the other alternatives.

e. Clean and ultra low sulfur diesel has a higher BTU value per gallon or equivalent gallon than any other alternative fuel, and thus provides more engine efficiency as well as more vehicle range.

f. Ultra low sulfur diesel offers significant reductions in emissions as indicated above

2) **Disadvantages:**

a. Clean diesel is still relatively high in particulates and Nox.

b. Clean and ultra low sulfur diesel are fossil fuels and, as such, leaves us still dependent on foreign sources.

c. When operating under cold conditions, starting is a problem, as with all diesel fuels.

d. Ultra low sulfur diesel is not readily available in most areas of the Country.

d. Reformulated gasoline:

Reformulated Gasoline is a specially blended fuel with the following properties: a lower vapor pressure that reduces evaporation during operation and refueling; more efficient combustion through the addition of high octane oxygenates. Reformulated gasoline aromatic levels have been lowered, which provides less in the way of hydrocarbon tail pipe emissions.

1) **Advantages:**

a. Reformulated gasoline is compatible with all existing gasoline engines.

b. The existing fuel delivery infrastructure is unchanged by this change in fuel properties.

c. Reformulated gasoline is a cost effective alternative in spite of some additional refining costs.

2) **Disadvantages:**

a. Currently there is insufficient oxygenate production and storage (as well as transportation) to provide the oxygenate when and where it is needed.

b. Like regular gasoline, reformulated gasoline has a lower caloric (BTU) value than diesel and, thus, provides less engine efficiency than diesel and less range for a given fuel capacity.

c. Reformulated gasoline is a fossil fuel and, as such, leaves us still dependent on foreign sources.

a. Present technology and federal emissions and energy standards will allow reformulated gasoline to be viable to the year 2000. Significant improvements must take place if gasoline is to be used after that time, assuming present planned regulations remain in place.

2. **Gaseous alternative fuels**

a. Natural gas

Natural gas is primarily methane as it comes from the well, and it burns quite cleanly in its unprocessed state. Natural gas has a higher ignition point (temperature) and a narrower fuel/oxygen mixture combustion range than other fuels. Energy is consumed in processing natural gas to achieve sufficient vehicle storage (i.e., compression or cryogenic processes). See Compressed Natural Gas and Liquid Natural Gas below.

b. Compressed natural gas (CNG)

Compressed Natural Gas, or CNG, consists primarily of mixtures of hydrocarbon gases and vapors, consisting principally of methane (CH4) in gaseous form, which is compressed for use as a vehicular fuel.

1) **Advantages:**

a. Natural gas is readily available as a domestic energy source, Is inexpensive, and has generally lower emissions than most other alternative fuels.

b. CNG already is in use as a viable alternative for light duty vehicles. The American Gas Association reports over 700,000 natural gas vehicles in operation in 38 countries.

c. The cleaner burning minimizes carbon buildup thus, increasing oil change intervals and reducing maintenance.

2) **Disadvantages:**

a. The pressure of CNG requires heavy storage tanks. The tanks are large even for short range use. Those two factors reduce cargo capacity. Maintaining reasonable cargo capacity restricts tank size and limits range. Lower caloric (BTU) value per equivalent gallon than diesel also limits engine efficiency and vehicle range.

b. The high pressure which the CNG fuel storage system must endure requires careful design and location on the vehicle, protection from damage, plus periodic maintenance and upkeep. Periodic tank testing for structural safety is required and replacement during the life cycle of the vehicle may be necessary.

c. Refueling time is dependent on the type of fueling system used, and can be quite lengthy. There are two methods: "slow fill" which takes from 5 to 8 hours and is typically called "overnight" or "time fill" refueling and "fast fill" which takes about 5 to 10 minutes and requires high volume compression and special filling apparatus.

a. Natural gas compression and refueling equipment is expensive and must be maintained. Fast fill capability requires an additional "cascade" of high volume storage cylinders, which adds considerable expense to the fueling station.

b. There are composition variations in natural gas and percentage of methane content from one area another. Additional processing is required to get uniform natural gas available in all areas.

c. Natural gas has poor lubricative properties.

c. Liquid natural gas (LNG):

Liquid natural gas utilizes the same natural gas source (primarily methane) as CNG, but requires purification of the gas and cooling and storage below −260 degrees Fahrenheit to liquefy the natural gas. Converting natural gas to liquid form provides storage of a much greater amount on the vehicle than can be achieved in the gaseous state.

1) **Advantages:**

a. Liquid natural gas has all of the combustion advantages of compressed natural gas, is readily available, clean burning and generally produces lower emissions than alternatives other than CNG.

b. An engine will operate just as easily on LNG as it does on CNG. Though one is stored by compression and the other by cryogenics, when either gets to the point of combustion, it is natural gas.

c. The range of an LNG is greater than that of CNG due to the fuel density.

d. The LNG fuel system pressure is less than 100 psig as compared to 3000 psig in a CNG system.

e. LNG provides almost pure methane with known performance characteristics.

2) **Disadvantages:**

a. Maintaining the super cool temperature requires large, heavy, highly insulated tanks which still forces compromise between vehicle range and cargo carried.

b. Equipment to super cool and liquefy gas is expensive to purchase, operate, and maintain.

c. Liquid natural gas can be kept in the insulated storage tank for 7 to 10 days. After that, it must be bled off to maintain the cold temperature required to hold the gas in liquid form.

d. The bleeding off process releases hydrocarbons which, in turn, requires treatment to avoid direct release into the atmosphere.

e. Natural gas has poor lubricative properties.

d. Propane (also known as LIQUEFIED PETROLEUM GAS or LPG)

Propane, or LPG, is sometimes available directly from wells, but is nominally produced as a by product of the gasoline refining process. It has been used for a number of years in light duty commercial vehicles in urban areas around the world.

1) **Advantages:**

a. Propane bums relatively clean. It emits less NOx and contains less particulate matter than diesel; and emits less carbon monoxide and fewer hydrocarbons than gasoline.

b. The cleaner burning minimizes carbon buildup in the engine and hence resulting in less maintenance.

c. Propane starts better in cold weather than either diesel or gasoline.

d. The infrastructure for distribution and storage of propane is relatively widespread.

2) **Disadvantages:**

a. As with CNG, propane requires large and heavy fuel tanks to achieve reasonable driving range, due to reduced engine efficiency per equivalent gallon.

b. Propane requires the use of relatively low compression ratios hence, has lower economy.

c. Propane vapors, like gasoline, are heavier than air and volatile. These explosive mixtures settle in service pits or other spots; therefore, indoor storage can be a safety concern.

a. As a by product, propane, is dependent on the gasoline process which limits supply. Further, it does little toward the reduction of dependency of foreign oil.

b. Propane has poor lubricate properties.

3. **Electric power**

The use of electricity as a power source for school buses is an emerging technology that is under considerable research due to the potential for reduced overall emissions. Research is centering on ways to increase the capacity and reduce the weight of batteries, as well as improving the motors used to power the vehicles and the associated electronics. Recharging technology is also developing rapidly. Most of these efforts have the goals of improving the range and performance of electric vehicles, reducing their cost, and addressing operational concerns, such as recharging emissions.

1) **Advantages:**

a. Electric power vehicles produce no tail pipe emissions.

b. The electricity distribution system is currently available; power lines are already in place.

c. Electricity can be, and often is, produced from renewable, domestic energy sources.

d. Electric power vehicles are extremely quiet, due to the lack of internal combustion engines.

e. Electric school buses can be produced as hybrid vehicles, which would have a small internal combustion engine to recharge batteries, or to supply heating systems or various other chassis accessories.

f. The cost per mile to operate electric power vehicles is low; power source maintenance is practically nil, compared to internal combustion engines.

2) **Disadvantages:**

a. Electric power vehicles have low range, due to battery weight and limited electrical storage capacity of current batteries.

b. Electric power vehicles may not eliminate overall emissions and/or foreign oil dependency if electricity to charge vehicle batteries is produced from coal or oil.

c. Current cost of electric power systems for vehicles, including batteries, is extremely high.

d. Battery disposal is an environmental Concern.

e. Significant weight of current batteries limits passenger carrying capacity.

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